Building N-226 Reuse Guidelines

NASA Ames Research Center, California

prepared for:

NASA/Ames Research Center

prepared by:

Architectural Resources Group

Architects, Planners & Conservators, Inc.

San Francisco, California

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Introduction

NASA Ames Research Center and Architectural Resources Group, Architects, Planners & Conservators, Inc. (ARG) have developed Reuse Guidelines for the 6 Foot by 6 Foot Supersonic Wind tunnel, Building N-226, at NASA Ames Research Center, California. The Reuse Guidelines have been designed to assist NASA Ames professional staff, tenants, and their consultants in rehabilitating historic structures by identifying character-defining features, outlining the opportunities for reuse and evaluating code deficiencies for each building.

I. Executive Summary

Constructed in 1948 along Moffett Field's western boundary, Building N-226, also known as the 6 foot by 6 foot Supersonic Wind Tunnel Laboratory Building, is a two-story, reinforced concrete, stripped classical-style building with Streamline Moderne and International style influences. Roughly T-shaped in plan, the building has a flat roof with steel truss framing, and consists of a central mass with projecting wings on either side. The building historically functioned as a supersonic wind tunnel used for supersonic flight research discoveries and testing for supersonic craft and missiles. There have been no significant alterations or additions to the building since 1948. (Refer to Appendix 6 for historic building plans.) The wind tunnel remained in operation until 1988, when the wind tunnel was decommissioned.

Building N-226 is individually significant at the national level for the National Register of Historic Places (NRHP) under Criterion A, for its role in supersonic testing and research and association with many significant aeronautic discoveries, and under Criterion C for its significant engineering accomplishments in the context of wind tunnel construction. The NRHP nomination was submitted to the State Historic Preservation Office (SHPO) for Historic Eligibility Determination in November 2006. (See Appendix 7 for Building N-226 National Register Nomination.) The building has a high degree of integrity; the building's character-defining features are intact on the exterior and interior. (Character-defining features, including significance and condition ratings are listed in section VII and Appendix 1.)

Rehabilitation of the building should comply with *The Secretary of the Interior's Standards for Rehabilitation (The Standards). The Standards* can be accessed on the National Park Service website (www.nps.gov) and are presently located at the following URL: http://www.nps.gov/history/hps/tps/tax/rhb. Plans for the reuse of Building N-226 should take into consideration the preservation of the building's character-defining and contributing features, including, but not limited to, the overall form of the building, fenestration pattern, materials, and open space. Changes to non-character-defining features may be undertaken, but the impact to the character-defining and contributing features evaluated.

Future renovations will require Fire/Life Safety and Disabled Accessibility upgrades to comply with current codes. These include, but are not limited to, the addition of fire sprinklers, exit path of travel and exit door upgrades, and disabled access improvements to door and door hardware, restrooms, and locker rooms. The impact of these upgrades to the character-defining and contributing features should be carefully considered before changes are made.

Further analysis is required for the management of hazardous materials and upgrades to the mechanical, electrical and structural systems. Existing mechanical flues, ducts and conduits protruding from windows and exposed on the exterior should be removed unless original. The impact of these upgrades to the character-defining and contributing features should also be carefully evaluated.

II. Project Team

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III. Methodology

ARG staff conducted site reviews of Building N-226 in January and October 2006. During the site visits, notes were taken on the character-defining features of the building and photographic documentation was completed on the exterior as well as major interior spaces. ARG staff utilized the available documents provided by the NASA Ames Research Center to assist in the development of this report. The documents provided by NASA Ames Research Center were used as a general reference in the production of this report. The verification of the accuracy of the documents was not included in the scope of work.

Site reviews were conducted with the understanding that the current use of the building would be continued. The site reviews were limited to a general observation of the buildings and building components and detailed survey of all interior spaces was not included in the scope of work. Furthermore, limited access to some areas of the building were required due to issues of security, privacy, safety, or other limitation.

ARG staff reviewed both primary and secondary research materials at the following institutions:

- Engineering Documentation Center located in building N-213; and
- Ames Imaging Library in building N-241.

The following documents were utilized as the main sources of information:

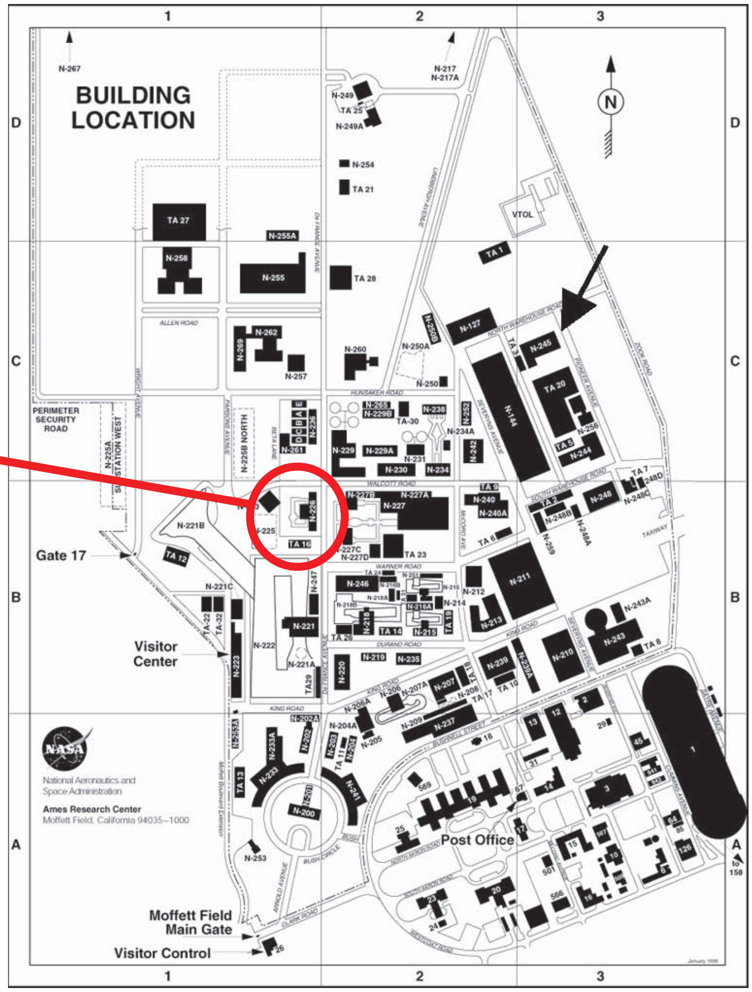
- The 1994 National Register of Historic Places Nomination Form for the US Naval Air Station Moffett Field Central Historic District;
- Aerial photographs dating from 1931 through 1944;
- Architectural Drawings including;
    - Ames Aeronautical Laboratory, Moffett Field, California. “Building N-226: 6 by 6 Foot Supersonic Wind Tunnel First Floor Plans.” Drawings dated 23 December 1945;
    - Ames Aeronautical Laboratory, Moffett Field, California. “Building N-226: 6 by 6 Foot Supersonic Wind Tunnel Laboratory Building Second Floor Plan.” Drawings dated 23 December 1945;
    - Ames Aeronautical Laboratory, Moffett Field, California. “Building N-226: 6 by 6 Foot Supersonic Wind Tunnel Elevations.” Drawings dated 23 December 1945;
    - Ames Aeronautical Laboratory, Moffett Field, California. “Building N-226: 6 by 6 Foot Supersonic Wind Tunnel Entrance Details and Overall Sections.” Drawings dated 23 December 1945.

View of the East and South Elevations of Building N-226.

IV. Building N-226 Summary

Location:	Moffett Field, California
Area:	NASA Ames Research Center
Date of Construction:	1948
Historic Structure:	Draft National Register Nomination submitted to SHPO Nov. 2006 for Historic Eligibility Determination.
Historic Use:	Offices and 6 by 6 Foot Supersonic Wind Tunnel
Current Use:	Offices, Education, and Museum
Hazard Level:	Ordinary, building is partially fire sprinklered
Number of Floors:	Two
1st Floor:	16,412 gross ft^2
Second Floor:	16,412 gross ft^2
Total:	32,824 gross ft^2
Exterior Materials:	Reinforced concrete
Construction Frame:	Reinforced concrete

Building N-226



"Ames Research Center, Moffett Field, California, Building Location Plan," February 2000.

V. Historical Background and Site Context

The NASA Ames Research Center was initially founded on December 20, 1939 as an aircraft research laboratory by the National Advisory Committee on Aeronautics (NACA), the forerunner agency of NASA. Ames has played a pioneering role in science and technology for over six decades. The center was named for Dr. Joseph S. Ames, NACA Chairperson from 1927 to 1939. Ames was NACA's second laboratory, established after the Langley facility in Hampton, Virginia. In 1958, Ames became part of the National Aeronautics and Space Administration (NASA). Since its inception, Ames researchers have broken new ground in all flight regimes—the subsonic, transonic, supersonic, and hypersonic—using a collection of wind tunnels and research aircraft, the sophistication of which has increased over time. Ames has evolved into a diverse and sophisticated research campus of buildings influenced by the clean lines and materials of the International style, fussed with elements of the Streamline Moderne; both styles are very well suited to industrial building types.

Ames specializes in research geared toward creating new knowledge and new technology, encompassing the fields of supercomputing, networking, numerical computing software, artificial intelligence, and human factors to enable advances in aeronautics and space. In aeronautics, Ames is the leading NASA agency in airspace operations systems, including air traffic control and human factors. Ames also has major responsibilities in the creation of design and development process tools and wind tunnel testing. Ames houses one of the world's largest collections of wind tunnels and simulation facilities.

The National Aeronautics and Space Administration (NASA) Ames Research Center borders the northern California towns of Sunnyvale and Mountain View near the heart of Silicon Valley. The Ames campus occupies approximately 430 acres of the approximately 2,000-acre Moffett Field site, which once served as a United States Naval Air Station – Sunnyvale. (See Appendix 4 for historic aerial photographs.)

The 6 by 6 Foot Supersonic Wind Tunnel Building is located on the western edge of Moffett Field, directly north of the 40 by 80 Wind Tunnel Structure. Identified as Building N-226, the 6 by 6 Supersonic Wind Tunnel Building is located on the southwest corner of the intersection of Boyd Road and De France Avenue. The two-story building is 32,800 total ft^2 (gross). Of that amount, the first floor contains 16,400 ft^2 (gross) of floor area and the second floor contains 16,400 ft^2 (gross) of floor area.

Exterior wind tunnel components are visible along the rear elevation. The original wind tunnel cooling tower is located behind the west (rear) elevation of the 6 by 6, and the spherical dry-air storage tank is immediately northwest of the 6 by 6. Both of these structures date to c.1948, when the 6 by 6 was originally constructed, and both structures contribute to the significance of the 6 by 6 Foot Wind Tunnel.

VI. Building Description

Historic Appearance

The 6 by 6 wind tunnel was originally constructed in 1948 as a two-story, stripped Classical and Streamline Moderne style concrete building with metal and wood tunnel support elements visible along the rear exterior walls. The front elevation of the building featured a symmetrical composition with a center volume flanked by projecting wings.

The wind tunnel's design was unique in that the building's design alluded to the supporting administrative functions inside, while the rear elevation hosted the exterior wind tunnel elements including the cooling coils, compressor, drive motors, and dry air storage tank.

Interior

The original interior ground floor configuration of the 6 by 6 Supersonic Wind Tunnel Laboratory Building consisted of office and meeting rooms (identified as rooms 103 through 109) on the southern end, one large open space (identified as Room 115) on the northern end, and a central shop section where models were produced for testing in the 6 by 6. Identified as Room 101, the Shop measured approximately 102 ft. by 90 ft. and contained wind tunnel machinery and equipment. Vacuum pumps and compressors for the wind tunnel were also located in this section.

The second floor originally consisted of office and meeting rooms on the southern end (identified as Rooms 204 through 208), additional rooms on the northern end (identified as Rooms 218 through 222), as well as the Optical Laboratory (identified as Room 217). The center portion of the second floor, the test section, contained the actual test chamber of the 6 by 6 Foot Supersonic Wind Tunnel, from which the tunnel's name is derived. The majority of the interior tunnel portions were located in the second floor test section, and along with the actual tunnel and test chamber. The second floor also featured a system of steel trusses, on which a moveable bridge crane and hoist system operated. The crane was used to hoist aerodynamic models from the first floor model shop up through an opening in the ceiling and then over and down into the 6 by 6 foot test chamber of the wind tunnel.

Also included in the second floor test chamber was the Schlieren photography equipment box, located on the east interior wall. The Schlieren system is an optical high-speed photography imaging system used for visualization of supersonic shock wave patterns. In addition to the equipment box, the wind tunnel test chamber contained a set of Schlieren disks that the laser beam passed through in order to photograph the effects of the airflow and shock patterns of the models.

The two windows weighed more than one ton, each and measured six inches thick, and fifty-two inches in diameter. According to one observers account in 1950:

> The most interesting thing to me about the 6 by 6 Foot Wind Tunnel were the side windows used to observe the behavior of the models being tested. The two windows are the largest optically ground glass lenses in the world. The glass was poured by the Corning Company and ground by Tinsley Company in Oakland.[1]

Modifications to the 6 by 6 Wind Tunnel

While the 6 by 6 was still in use as a wind tunnel, the structure underwent few alterations and/or modifications. Early in the life of the 6 by 6, researchers discovered that the tunnel could not obtain data in the transonic ranges. This discovery prompted Ames staff member Charles Hall to explore modifications to the original design of the 6 by 6 wind tunnel. The alterations to the tunnel were completed in 1955 and the exact specifications of these alterations are unknown. No other modifications were made to the structure between 1955 and the late 1980s, when the wind tunnel was decommissioned.

After the 6 by 6 was decommissioned, the center portion of the building's second floor was adaptively remodeled for use as the Ames Aerospace Encounter, which opened in October 1991. The Ames Aerospace Encounter is a math and science-based educational program that teaches 4th, 5th and 6th grade students about science and technology in relation to space and aeronautics. The interior elements of the historic wind tunnel were incorporated into the educational program.

Current Appearance of the 6 by 6 Wind Tunnel
Overall, in form, materials and details, the 6 by 6 Supersonic Wind Tunnel Laboratory Building retains its historic appearance. The building was designed in a stripped Classical style with an observable influence by the International and Streamline Moderne styles. The two-story, flat roofed building has a general rectangular plan. The symmetrically designed building is divided into three sections with a center section flanked by a wing on each side. Each wing measures 79 ft. 4 in. in by 50 ft. 4 in. wide (depth of wing portion) and the center section is 90 ft. long by 120 ft. deep.

The front (east) elevation features a central slightly recessed element measuring approximately 47 ft. tall and flanked on each side by a long wing. The recessed façade contains double doors that lead to the ground floor model shop space that now serves several miscellaneous uses. Above the entrance is a pre-cast mitered concrete panel that is now partially covered with signage displaying "NASA 6 by 6 Foot Supersonic Wind Tunnel." The original pre-cast panel most likely displayed lettering reading "NACA" indicating the building was originally constructed during the administration of the National Advisory Committee on Aeronautics (NACA). Above the double doors is a cantilevered concrete canopy featuring rounded corner edges indicative of the Streamline style. The central façade contains eight windows; two on the ground floor, three on the second floor, and, three rectangular shaped louvered windows above the second floor windows.

The two wings are horizontally divided into three sections by alternating bands of smooth concrete, separated horizontally by rusticated concrete wall portions. A large metal hopper window with a nine-pane sash separates each rusticated wall section.

The exterior body of the wind tunnel and its related machinery obstructs view of the building's rear (west) elevation. This includes the cooling coils, the compressor and the drive motors.

In close proximity to the cooling tower are two spherical dry air storage tanks. The tall metal structures consist of a spherical tank supported by steel wide-flange posts and a concrete foundation.

Currently, the interior spaces on the first floor serve as a storage facility and likely house other miscellaneous uses. The southern portion of the second floor is used for office and meeting spaces. The current use of these interior spaces is consistent with the original use. The interior wind tunnel elements located in the second floor test section, including the Schlieren photography box, the original control panels, tunnel sections, and model craft test chamber, are extant and were incorporated into the educational format of the Ames Encounter program.

(Footnotes)
[1] "Work At Ames Lab. Proves Eye Opener," *Daily Palo Alto Times*, July 11, 1950.

VII. Historic Character-Defining Features

Refer to Appendix 1 for a matrix of character defining features, including specific location of building components. For illustrated plans and elevations, see Appendix 3, Significance Diagrams.

Alteration of significant and contributing building components shall be in keeping with original design, configuration and material. For more information, see *The Secretary of the Interior's Standards for the Treatment of Historic Properties. The Standards* can be accessed on the National Park Service website (www.nps.gov) and are presently located at the following URL: http://www.nps.gov/history/hps/tps/tax/rhb.

See Appendix 5, Current Conditions Photographs for photos showing the character-defining building components listed below. For building floor plans, see Appendix. 2, Existing Floor Plans and Rehabilitation.

1. Significant Character-Defining Features: these are the features that convey the building's historic character and significance. Alteration or removal of these features could result in a loss of integrity and should be avoided.

The following are significant features:

- Overall form—large, central block with exposed wind tunnel on rear (west) elevation;
- Cantilevered streamline style concrete canopies (east elevation);
- Recessed front façade—flanked by wings;
- Walls
    - o Reinforced concrete walls;
    - o Concrete surface articulated with stripped Classical style striping (central block and south and north wings);
    - o Concrete wall surface articulated with grid of control joints (center block and elevator/toilet room blocks);
    - o Ornamental striping (center block parapet);
    - o Louvered openings (above second floor windows on center block;
    - o Ornamental banding over doors and below canopies at

Illustration 1: Cantilevered streamline style concrete canopies are significant features. (Source: ARG, October 2007)

Illustration 2: Exposed open web steel truss system are a significant feature. (Source: ARG, October 2007)

Illustration 3: Multi-lite, steel-sash windows with hopper segments are significant features. (Source: ARG, October 2007)

Illustration 4: Three-lite, wood panel doors are significant features. (Source: ARG, October 2007)

Illustration 5: Ornamental striping throughout exterior is a significant feature. (Source: ARG, October 2007)

Illustration 6: The vertical acting counterbalanced door is a significant feature. (Source: ARG, October 2007)

wings (east elevation);

  - Openings with glass block (elevator/toilet room blocks)
- Windows
  - Large metal hopper windows (see Building Summary photo at beginning of section III);
  - Multi-lite metal sash windows with operable hopper segments (on center block and south and north wings);
- Doors
  - Metal roll-up doors;
  - Multi-lite metal panel sliding doors and door tracks (east elevation);
  - 3-lite wood door (south elevation center block);
  - 3-lite, 1-panel wood door (center block);
  - 3-lite, 1-louver panel wood door with cantilevered awning (west elevation south wing);
  - Vertical acting counterbalanced door at freight elevator;
- Stairs
  - Configuration of stairs;
  - Interior stair handrails and guardrails (south wing/north wing);
- Interior freight elevator (including machine room);

Center wing (shop)

- Large open volume;
- Trench pit and manhole (west side of shop);
- Exposed steel columns in shop;
- Exposed open web steel trusses and joists, and diagonal floor sheathing in shop;
- Monorail and ceiling hatch (east side of shop);
- Test section tunnel (no photo available);
- Configuration of original walls and floors;

North wing (storage)

- Large open volume;
- Exposed concrete columns;

- Exposed concrete beams, joists, and decking;
- Configuration of original walls and floors (second floor);
- Corridors (north wing second floor)
    - Configuration
    - Floors
    - Walls
    - Ceilings
- Office wood flush veneer doors and frames (north wing first floor);

South wing (offices, first and second floor)

- Film reading room (second floor);
- Dark room (second floor);
- Corridors (south wing, first floor)
    - Configuration
    - Floors
    - Walls
    - Ceilings

Test Chamber (center wing second floor)

- Large open volume;
- Original configuration of walls and floors;
- 3 ft. by 3 ft. plates (floor);
- Exposed open web steel trusses and corrugated metal roofing;
- Test Section tunnel;
- Stairs over the wind tunnel test section tunnel (provide access to either side of test chamber room, over the wind tunnel);
- Steel ladder rungs and platforms to elevator machine room and fan room;
- Crane assembly (suspended “I” beam tramrails, crane hoist, and traveling crane dolly);
- Optical Laboratory (west side north wing second floor)
- Original ceilings; and
- Wood flush veneer doors and frames.

2. Contributing Features: these features are important elements that contribute to the understanding of the original design. Alteration or removal of these features may be necessary for programmatic or building system requirements. However, removal should be minimized and where necessary mitigated.

The following are contributing features:

South wing (offices, first and second floor)

- Interior configuration of offices (south wing first floor);
- Interior walls (south wing first floor);
- Interior ceilings (south wing first floor);

Film Reading Room (south wing second floor)

- Original configuration of interior walls and ceiling;
- Wood flush veneer door and frame;

Dark Room, south wing second floor

- Original configuration of interior walls and ceiling;
- Wood flush veneer door and frame;

Toilet Rooms

- Interior configuration of toilet rooms; and
- Plumbing fixtures in toilet rooms (south wing/north wing).

3. Tertiary Features: these features are original elements of the building that are of a lower importance relative to the understanding of the original design. Alteration or removal of these features, if necessary, would have a limited affect on the integrity of the building.

There are no tertiary features.

4. Non-Contributing Features: these features are elements of the building that have been remodeled or areas where additional alteration would not affect the original integrity of the building. In some cases, removal of the non-contributing features may be beneficial to the historic integrity of the building.

The following are non-contributing features:

Doors

- Metal aluminum storefront door (east elevation);
- Metal panel doors single-lite metal door with transom (south elevation, infilling 1 section of multi-lite metal sash window on south elevation);
- Metal panel doors single-lite metal door with transom (infilling 1 section of multi-lite metal sash window on west elevation);

- Single-lite metal door with transom (infilling 1 section of multi-lite metal sash windows on north and south wings);

Floors (no photos available)

- Interior office floors (south wing first floor);
- Film Reading Room floor;
- Dark room floor;
- Optical laboratory floor;

Ceilings

- Acoustic suspended ceiling/tile; and

Equipment

- AC units in windows.

5. Conservation of Intact Historic Fabric

The following materials require special care and treatment in their maintenance and rehabilitation:

- Concrete: Concrete cleaning and concrete spall repair should be undertaken with an architectural conservator; and
- Steel sash windows: If replacement of any of the steel sash windows is undertaken in the future, then it is important that architectural specifications be developed that require frames and muntin bars be duplicated exactly as they appear in the original windows with respect to dimensions and surface texture.

VIII. Opportunities for Reuse

The building currently functions well as an educational facility at the second floor with supporting offices at the north and south wings. The former shop area at the first floor center bay and the generator/electrical room at the first floor north bay are used for ad hoc storage. A more developed use for the shop area could include interpretive and educational uses in support of the second floor science/space curriculum.

IX. Code Evaluations and Recommendations

A. Fire/Life Safety

Description

Constructed in 1946, Building N-226 is a two-story building, with the main entrances fronting on De France Avenue. The exterior of the building has remained largely the same as originally constructed. Throughout the building there have been upgrades to the life safety systems and disabled accessibility components. The offices at the south and north wings have been remodeled, with changes primarily to finishes, along with the addition of some interior partitions. The second floor area adjacent to the test chamber has been converted to a children's aerospace educational use, with the addition of interpretive exhibits. The shop area at the first floor center bay has had offices added at the northeast corner of the room. The building has a gross floor area of 32,824 ft^2 and consists of concrete exterior walls, concrete floors at second floor office wings and first floors, steel trussed roof and floors at center bay (test chamber and shop), and a concrete roof structure at the office wings. The building was reviewed for general code compliance with the provisions of the 2001 California Building Code (CBC).

Building N-226 is a mixed occupancy building with the office areas classified as B occupancy, the education area at the second floor center bay (test chamber) classified as E2, and the shop areas at the first floor center and north bays classified as F2. The construction type is Type III-N. The following review is based on the occupancies remaining the same. If a change in occupancy is proposed, further detailed code analysis will be required. Section VIII B. includes a glossary of building Construction Types and Occupancy Types that exist within the scope of this report.

California's State Historical Building Code (SHBC), located in chapter 34 of the CBC, shall be used in conjunction with the California Building Code as stated in section 8-102.1: "These regulations are applicable for all issues regarding building code compliance for qualified historical buildings or properties. These regulations are to be used in conjunction with the regular code to provide alternatives to the regular code to facilitate the preservation of qualified historical buildings or properties. These regulations shall be used whenever compliance with the regular code is required for qualified historical buildings or properties."

Fire/Life Safety Analysis

1. Construction type: Building N-226 is currently classified as a mixed occupancy B, E2, and F2 occupancies, and Type III-N construction. Table 5A of the CBC allows Occupancy B, E2, and F2 to be construction type III-N. There is a fire alarm and perimeter door security system in place, and a fire suppression system in the exit stairs, and in the E2 and F2 occupancies (Center bay Test Chamber and Shop areas). The north and south office wings do not have a fire suppression system.

> *Recommendation*: The building Construction Type is allowable for the Occupancy Type currently housed in the building.

2. Location on Property: CBC Table 5-A limits the exterior bearing walls to be minimum four-hour non-combustible for E2 occupancy; for F2 and B occupancies bearing walls shall be four hour non-combustible less that 5 ft. from property lines and two hour non-combustible elsewhere. Building N-226 exterior walls are 8 in. thick concrete walls and they meet the requirement. Exterior openings for all occupancies are required to be protected less than 20 ft. from property lines. Building N-226 is separated more than 20 ft. in width on four sides and does not need exterior opening protection. The wind tunnel at the west is considered part of the building for purposes of opening protection.

> *Recommendation*: Modifications to the building based on the location of property are not required.

3. Occupancy Separation: According to CBC Table 3B, the following occupancy separations are required: there is no required occupancy separation between B and F2 occupancies; there is one-hour occupancy separation between F2 and E2, and between E2 and B. CBC section 8-302.3 states, "Required occupancy separations of one hour may be omitted when the building is provided with an approved automatic sprinkler system throughout." The areas of the building that house the F2 and E2 occupancies are fully sprinklered, including the adjacent exit stairs.

> *Recommendation*: Building occupancy separations conform to the requirements of the occupancy types currently housed in the building.

4. Allowable Area: Building N-226 is separated on three sides by yards in excess of 20 ft. (for a total of 40 ft. minimum on all sides.) CBC 505.1.2 allows for an area increase at the rate of 2.5% for each foot where the yard exceeds 20 ft., resulting in an area increase of 50% for building N-226. By using CBC Table 5-B and the allowable area increase, the net allowable areas for the mixed occupancies for Type III-N construction is as follows: B occupancy allowable area is 24,000; E2 occupancy allowable area is 20,250; F2 allowable area is 36,000 ft^2.

CBC section 504.3 states, "When a building houses more than one occupancy, the area of the building shall be such that the sum of the ratios of the actual area for each separate occupancy divided by the total allowable area for each separate occupancy shall not exceed one." When the calculation for a mixed occupancy building is performed in accordance with CBC section 504.3, building N-226 mixed occupancy does not exceed the allowable area.

> *Recommendation*: The building is within the allowable area.

5. Allowable Height: Table 5-B of the CBC limits the number of stories of the building to 2 stories and an overall height of 65 feet for Construction Type III-N. SHBC section 8-302.5 allows the height of the structure to not be limited, "provided such height or number of stories does not exceed that of its designated historical design."

> *Recommendation*: The building is within the allowable height.

6. Means of Egress Identification: Section 1003.2.8.2 requires the path of travel to and within exits to be identified with code compliant exit signs. Illuminated exit signs with battery back-up power source have recently been installed. CBC 1003.2.9 requires the means of egress serving the occupied portion to be illuminated at an intensity of not less than 1 footcandle at the floor level. The emergency lighting in building N-226 corridors, exit stairs, and high-occupancy spaces appears to comply with this requirement.

> *Recommendation*: The Means of Egress system appears to be code compliant.

7. Doors: CBC Section 1003.3.1.3 requires a clear opening of 32 inches. A general survey of the doors found that doors are typically a compliant width, a detailed survey should be undertaken to confirm door width compliance. CBC section 1003.3.1.5 requires the door to swing in the direction of egress. Section 1003.3.1.6.2 requires a level landing on each side of all doors that are part of the means of egress system. This section also requires the landing to be 44 in. in length when the door swings away and 60 in. in the direction of the door swing. Currently, all of the exits and doors appear to meet these requirements.

> *Recommendation*: A detailed survey of all doors should be undertaken to confirm compliant door width, clearances and hardware operation.

8. Stairs and Guardrails: CBC section 1003.3.3.3 requires the rise and run of the stair to be a minimum of 7 in. and 11 in. respectively. CBC section 1003.3.3.6.1 requires all stairs (two or more risers) to have a handrail on each side. CBC section 1133B.4.2.6.1 requires handrails to have a maximum cross section dimension of 1-1/2 in., the existing handrails are 2 in. in width and are non-compliant. The exterior exit stairs lack required handrails. Section 509 of the CBC requires 42 in. high guardrails at all unenclosed floor or roof openings, open or glazed stairways, aisles, landings, ramps, balconies, or porches, which are over 30 in. above grade or the floor below. Interior guardrails at stair landings are 36 in. high and are non-compliant. Exterior exit stairs meet this requirement. SHBC section 8-502.1 exception 5 allows the enforcing agent to accept "any other condition which will allow or provide for the ability to quickly and safely evacuate any portion of a building with out undue exposure and which will meet the intended exiting and life safety stipulated by these regulations."

> *Recommendation*: At exterior stairs, provide compliant handrails. At interior exit stairs, augment existing guardrail with compliant guardrail and add a compliant handrail at each side of the stair.

9. Ramps: There are no ramps in the building.

10. Exiting: CBC section 1003.2.5 requires exit continuity: "The path of exit travel along a means of egress shall not be interrupted by any building element other than a means of egress component as specified in this chapter." The exit stair from the second floor center bay (Test Chamber) is enclosed at the second level, but terminates in the Shop area, resulting in the exit path of travel through an intervening space. CBC Section 1004.3.4.2 requires corridors to be a minimum width of 44 in., or if serving an occupant load of less that 50, shall be a minimum width of 36 in. The existing 72 in. wide corridors are compliant. Emergency exterior exit stairs have been added to the ends of each of the office wings to provide a second means of egress from each of the three office wings. To access the stairs, a steel ladder is provided at the windowsill height.

Recommendation: At the egress stair from the Test Chamber (southwest corner of room) provide an exit enclosure that leads directly to the exterior, the existing exit door at the first floor could be used for exiting to the exterior. At the emergency exits at the Second Floor offices, provide compliant stairs, handrails, and guardrails to replace the existing steel ladder that leads to the emergency exit at the windows.

11. Travel distance: Section 1004.2.5.2.1 requires that the maximum travel distance in non-sprinklered buildings not exceed 200 ft. (building is partially sprinklered.) Travel distance is that distance an occupant must travel from any point within occupied portions of the exit access to the door of the nearest exit. Where path of travel includes unenclosed stairways or ramps, the distance of travel on such components must be included in the travel distance measurement. The interior stairways are well within the travel distance required. The travel distance from any portion of the building to the exterior is within the required travel distance.

Recommendation: Travel distance for exiting is within the required travel distance.

Summary of Fire/Life Safety Recommendations

1. Construction type: The building construction type is allowable for the Occupancy Type currently housed in the building.

2. Location on Property: Modifications to the building based on the location of property are not required.

3. Occupancy Separation: Building occupancy separations conform to the requirements of the occupancy types currently housed in the building.

4. Allowable Area: The building is within the allowable area.

5. Allowable Height: The building is within the allowable height.

6. Means of Egress Identification: The Means of Egress system appears to be code compliant.

7. Doors: A detailed survey of all doors should be undertaken to confirm compliant door width, clearances and hardware operation.

8. Stairs and Guardrail: At exterior stairs, provide compliant handrails. At interior exit stairs, augment existing guardrail with compliant guardrail and add a compliant handrail at each side of the stair.

9. Ramps: There are no ramps in the building.

10. Exiting: At the egress stair from the Test Chamber (southwest corner of room) provide an exit enclosure that leads directly to the exterior, the existing exit door at the first floor could be used for exiting to the exterior. At the emergency exits at the Second Floor offices, provide compliant stairs, handrails, and guardrails to replace the existing steel ladder that leads to the emergency exit at the windows.

11. Travel distance: Travel distance for exiting is within the required travel distance.

B. Glossary of Terms: Construction and Occupancy Types

The following is a summary description of the Construction and Occupancy Types for building N-226:

Glossary of Construction Types, referenced from the 2001 California Building Code:

Type III-N	Structural elements in Type II buildings may be of any materials permitted by this code. Exterior walls shall be constructed of noncombustible materials and shall comply with the fire-resistive requirements set forth in CBC Section 503 and Tables 5-A and 6-A. Bearing partitions, when constructed of wood, shall comply with CBC Section 2308.

Group B	A building or structure, or a portion thereof, for office, professional or service-type transaction, including storage of records and accounts; eating and drinking establishments with an occupant load of less than 50.
Group E2	Any building used for educational purposes through the 12th grade by less than 50 persons for more than 12 hours per week or four hours in any one day.
Group F2	Low-hazard factory and industrial occupancies include facilities producing noncombustible or nonexplosive materials that during finishing, packing or processing do not involve a significant fire hazard.

C. Disabled Accessibility

Disabled Accessibility Analysis

1. Accessible Parking: CBC section 1129B.1 requires that where parking is provided for the public as clients, guests, or employees, accessible parking will also be provided. Section 1129B.4 requires one van accessible space for every eight accessible spaces, with a minimum of one van space. Van accessible parking spaces require an 8-foot wide loading area adjacent the parking space instead of the 5-foot wide loading area required for accessible parking stalls. Total number of parking spaces at the south parking lot for Building 226 is approximately 10. CBC Table 11B-6 requires a minimum of one van accessible parking spaces for this lot capacity.

Recommendation: Provide disabled accessible parking at the existing parking lot.

2. Accessible Route: CBC section 1114B.1.2 requires an accessible route of travel to all portions of the building that are required to be accessible. The SHBC Section 8-604 allows for equivalent facilitation to be provided in lieu of a path of travel to all areas of the building where providing access "would threaten or destroy the historical significance or character-defining features of the building or site or cause unreasonable hardship." There is no compliant disabled accessible path of travel from the parking lot to the entrance door. The entrance Foyer to the south wing (offices) has a two-riser stair at the corridor. There is no disabled accessible route to the second floor; there is only a freight elevator. The test chamber room lacks disabled access to all parts of the room due to the existence of the wind tunnel within the room. There is access over the wind tunnel by way of a steel stair construction, and a circuitous path of travel at the second floor level that travels through the wind tunnel.

Recommendation: Provide disabled accessible path of travel from the parking area to the front entrance. Modify the existing entrance to the south wing to allow for disabled accessible travel to first floor level. Provide disabled access to the second floor level by means of an elevator or other vertical access system. Recommend study of the use of the existing freight elevator as a possible passenger elevator location, or other central location within the building. At the test chamber room, disabled access to the western portion of the room is necessary if the room continues to be used in its current arrangement.

3. Doors: Section 1133B.2.4 of the CBC requires a level landing on each side of a door. Section 1133B.2.4.2 requires maneuvering clearance to be 60 in. on the swing side of interior doors and 48 in. on the non-swing side of the door with a closer (44 in. without closer). The clearance on the swing side shall extend 18 in. beyond the strike side of the door for interior doors and 24 in. on exterior doors. The clearance for the non-swing side shall extend 12 in. when the door has a closer. Section 1133B.2.5.2 requires hardware that is hand operable with a single effort without requiring the ability to grasp. Most doors at Building N-226 lack lever-handled hardware. At the east elevation, the entrance doors to the south Office wing is approximately 1 in. below the finish floor, and does not comply with the maximum ½ in. level change at doors required by CBC section 1133B.2.4.1.

Recommendation: Provide replacement lever-handled door hardware at existing doors, where knobs are non-compliant. Correct the difference in floor level between the entrance walk to the south wing and the finish floor level. This work should be undertaken as part of the disabled accessible upgrades to access to the first and second floors described in Item 2 above.

4. Stairs: Section 1133B.4.4 of the CBC requires striping for the visually impaired on the lowest and upper most treads of a run of stairs. Currently most of the interior and exterior stairs meet this requirement. CBC Section 1133B.4.2 requires handrails to extend 12 in. beyond the top nosing and 12 in. plus the tread width, beyond the bottom nosing. Interior and exterior stairs do not meet this requirement.

Recommendation: Correct the stair handrail extensions to comply with current code.

5. Restrooms: CBC section 1115B.1 requires buildings that are required to be accessible to have accessible restrooms. The restrooms have been made partially accessible at the second floor; the restrooms at the first floor have not been upgraded for disabled access. A detailed confirmation of non-conforming conditions should be undertaken at a future phase of project development.

Recommendation: Correct non-compliant disabled accessible bathroom fixtures, heights, and clear area requirements.

6. Drinking Fountain: Section 1117B.1.1 of the CBC requires where water fountains are provided, they shall comply with the requirements of this section. Section 1117B.1.2 of the CBC requires water fountains to be located in an alcove not less than 32 in. wide and 18 in. in depth, or so as not to encroach in the pedestrian ways. The drinking fountain complies with the accessibility requirements of the code.

Recommendation: Drinking fountains appear to be code compliant.

7. Signage: Sections 1103.2.4, 1127B.3, 1129B.5, and 1115B.5 of the CBC require code-compliant signage identifying accessible entrances, parking, areas of refuge, passenger loading zone, toilet and bathing facilities, and exit signage at the exit stairs. In addition to the international symbol of accessibility, each unisex toilet or bathing room shall be identified by a tactile sign including raised letters and Braille. There is compliant disabled accessible signage at the separate Men’s and Women’s restrooms at the second floor only. There is no accessible signage at the main building entrance.

Recommendation: Provide disabled accessible building entrance signage at the main entrance; coordinate this work with the correction of the building path of travel upgrade work.

Summary of Disabled Accessibility Recommendations

1. Accessible Parking: Provide disabled accessible parking at the existing parking lot.

2. Accessible Route: Provide disabled accessible path of travel from the parking area to the front entrance. Modify the existing entrance to the south wing to allow for disabled accessible travel to first floor level. Provide disabled access to the second floor level by means of an elevator or other vertical access system.

Recommend study of the use of the existing freight elevator as a possible passenger elevator location, or other central location within the building. At the test chamber room, disabled access to the western portion of the room is necessary if the room continues to be used in its current arrangement.

3. Doors: Provide replacement lever-handled door hardware at existing doors, where knobs are non-compliant. Correct the difference in floor level between the entrance walk to the south wing and the finish floor level. This work should be undertaken as part of the disabled accessible upgrades to access to the first and second floors described in Item 2 above.

4. Stairs: Correct the stair handrail extensions to comply with current code.

5. Restrooms: Correct non-compliant disabled accessible bathroom fixtures, heights, and clear area requirements.

6. Drinking Fountain: No improvements needed.

7. Signage: Provide disabled accessible building entrance signage at the main entrance; coordinate this work with the correction of the building path of travel upgrade work.

D. Energy Conservation

Analysis

The historic structure was designed with some energy-conserving features; monolithic concrete floors throughout the building and thick concrete walls contribute to passive climate control for the building. Insulation in the exterior walls could not be confirmed without destructive testing. The majority of the window sashes are single glazed. The building has a mixed mechanical system comprised of a forced air mechanical system, and window-mounted packaged air conditioning units. Consideration should be given to replacing the packaged air conditioning units with an energy efficient single-source system. The efficiency of the mechanical systems could not be confirmed. Energy efficient fluorescent lighting is the primary lighting source.

Recommendation: Building N-226 has been submitted to SHPO for a determination of eligibility for the National Register of Historic Places and could be exempt from energy code requirements. However, measures to reduce energy consumption and provide for user comfort are recommended. These actions may include insulating the ceiling and exterior walls during future construction work. The existing steel sash windows are historic features and should be repaired and weather-stripped rather than replaced. High efficiency mechanical systems should be used to replace mechanical systems that have reached the end of their useful life.

X. Future Studies Needed

A. Hazardous Materials

Although a hazardous materials report has not yet been completed, there are several types of historical materials and finishes are known to contain asbestos and other hazardous materials in the building construction. Most painted older surfaces in the building likely have some lead-based paint residues, and should be confirmed through testing.

It is recommended that a complete hazardous materials report be completed on the building.

B. Mechanical and Electrical Systems

The mechanical and electrical systems were not inspected as part of this report. It is assumed that should the rehabilitation and reuse of Building N-226 be undertaken, it will entail the installation of an upgrade to mechanical and electrical systems, and potentially the plumbing drainage/waste system. All new mechanical and electrical systems should be designed to preserve the character of the significant materials and spaces identified in this report.

C. Structural Systems

The exterior walls of Building N-226 are reinforced concrete. The roof and floor structures are reinforced concrete construction. The first floor center and north bay floor construction is a concrete slab on grade. Exterior stairs are steel frame construction.

The building appears to be in excellent condition. In the course of rehabilitating the building the structural system should be analyzed for seismic and gravity load deficiencies and reinforced as necessary. Strengthening provisions should be designed to preserve significant materials and spaces.

NASA Ames Research Center
Building 226 Reuse Guidelines

Appendix 1. Character-Defining Features

Character-Defining Features

Elements	Significance	Condition	Comments
Exterior			
North Elevations			
Concrete surface articulated with classical style striping, emphasized horizontality	S	G	board form smooth concrete, soiled and discolored
Windows:			
Multi-lite metal sash windows with operable hopper segments (wing and center block beyond)	S	F	window mounted air conditioners, wire mesh on lower left and right bay
Louvered openings (center block beyond- with fans behind)	S	F	
Doors:			
Metal roll-up door	S	G	
Ornamental striping (center block parapet)	S	G	
East Elevation (including courtyard)			
Concrete surface articulated with classical style striping, emphasized horizontality (south and north wings)	S	G	soiled and discolored
Concrete surface articulated with grid of control joints (center block and elevator/toilet room blocks)	S	G	soiled and discolored
Windows:			
Multi-lite metal sash windows with operable hopper segments	S	F	window mounted air conditioners, black-out shades inside
Louvered openings (center block above second floor windows)	S	F	
Openings with glass block (elevator/toilet room blocks)	S	F	
Doors:			
Multi-lite metal panel sliding doors	S	F	
Metal aluminum storefront doors with sidelights	N	G	

Significance Rating
S=Significant
C=Contributing
T=Tertiary
N=Non-contributing

Condition Rating

G=Good
F=Fair
P=Poor

Cantilevered streamline style concrete canopies with rounded corners over doors	S	P	spalling and deterioration
Ornamental banding (over doors and below canopies at wings)	S	P	spalling and deterioration
Ornamental striping (center block parapet)	S	G	
South Elevation			
Concrete surface articulated with classical style striping, emphasized horizontality	S	G	stained
Windows			
Multi-lite metal sash windows with operable hopper segments (wing and center block beyond)	S	F	one modified to provide an exit door; window mounted air conditioners
Doors:			
Single-lite metal door with transom (infilling one section of multi-lite metal sash window)	N	G	
3-lite 1-panel wood door with cantilevered awning (center block)	S	P	
Ornamental striping (center block parapet)	S	G	
Cantilevered streamline style concrete canopy with rounded corners over doors at the corner (center block)	S	P	spalling and deterioration
West Elevation			
Concrete surface articulated with classical style striping, emphasized horizontality	S	G	stained, north and south wings
Concrete surface articulated with grid of control joints (center block)	S	G	
Windows			
Multi-lite metal sash windows with operable hopper segments	S	P/F	two modified to provide metal doors; window mounted air conditioners

Significance Rating
S=Significant
C=Contributing
T=Tertiary
N=Non-contributing

Condition Rating

G=Good
F=Fair
P=Poor

Louvered openings (center block beyond- with fans behind)	S	F	
Doors:			
Single-lite metal door with transom (north and south wings)	N	G	
3-lite 1-panel wood door (center block)	S	P	
3-lite 1-louver panel wood door With Cantilevered Awning (south wing)	S	P	
Ornamental striping (center block parapet)	S	G	
Interior			
Offices (south wing first floor)			
Configuration	C	G	
Floors	N	G	
Walls	C	G	
Ceilings	C	G	
Doors:			
Wood flush veneer doors and frames	S	G	
Blackboards			removed
Corridors (south wing first floor)			
Configuration	S	G	
Floors	S	G	
Walls	S	G	
Ceilings	S	G	
Toilet Rooms (south wing first floor, toilet room block first floor and mezzanine landing/south wing second floor/toilet room block second floor)			
Configuration	C	G	
Floors	C	G	
Walls	C	G	
Ceilings	C	G	
Plumbing fixtures	C	G	
Stairs (south wing/north wing)			

Significance Rating
S=Significant
C=Contributing
T=Tertiary
N=Non-contributing

Condition Rating
G=Good
F=Fair
P=Poor

Configuration	S	G	
Floors	S	G	
Walls	S	G	
Ceilings	S	G	
Handrails/guardrails	S	G	metal handrail-later additon and non-contributing
Elevator (including machine room)			
Walls	S	G	
Floor	S	G	
Ceiling	S	G	
Doors:			
Vertical acting counterbalanced door	S	G	
Shop (center wing first floor)			
Large open volume	S	F	partitions-later addition
Floor	S	P	
Trench pit, and manhole (west side)	S	G	trench pit covered and runs partial length of floor
Door track (east side)	S	P	
Walls	S	G	
Exposed steel columns	S	F	
Exposed open web steel trusses and joists, and diagonal floor sheathing	S	G	
Doors:			
Metal roll-up door	S	F	
Test Section Tunnel	S	F	
Stairs	S	G	
Monorail and ceiling hatch (east side at exterior door)	S	G/F	
North Wing (current use-storage)			
Large open volume	S	G	

Significance Rating
S=Significant
C=Contributing
T=Tertiary
N=Non-contributing

Condition Rating

G=Good
F=Fair
P=Poor

Floor	S	F	grating in floor covers engines
Walls	S	F	
Exposed concrete columns	S	G	
Exposed concrete beams, joists, and decking	S	G	
Offices (south wing second floor, north wing second floor)			
Configuration	C	F	
Floors	N	G	
Walls	C	G	
Ceilings	C	G	
Doors:			
Wood flush veneer doors and frames	S	G	
Corridors (south wing second floor, north wing second floor)			
Configuration	S	G	
Floors	S	G	
Walls	S	G	
Ceilings	S	G	
Film Reading Room (south wing second floor)			
Floor	N	G	
Walls	C	G	dividing wall between film reading room and dark room has been removed
Ceiling	C	G	
Wood flush veneer door and frame	C	G	
Dark Room (south wing second floor)			
Floor	N	G	
Walls	C	G	
Ceiling	C	G	

Significance Rating
S=Significant
C=Contributing
T=Tertiary
N=Non-contributing

Condition Rating
G=Good
F=Fair
P=Poor

Doors:			
Wood flush veneer doors and frames	C	G	one door missing
Test Chamber (center wing second floor)			
Large open volume	S	G	
Floor	S	G	
3 ft. x 3 ft. flush metal plates	S	G	
Walls	S	G	
Exposed open web steel trusses and corrugated metal roofing	S	G	
Doors:			
Wood flush veneer doors and frames (at elevator machine room and fan room)	S	G	
Test Section Tunnel	S	G	
Stairs (to test section tunnel)	S	G	
Steel ladders and platforms (to elevator machine room and fan room, east side)	S	G	
Crane assembly (suspended “I” beam tramrails, crane hoist, and travelling crane dolly)	S	G	
Optical Laboratory (west side north wing second floor)			
Open volume			partition added
Floor	N	G	
Walls	C	G	
Ceiling	C	G	
Doors:			
Wood flush veneer doors and frames	S	G	

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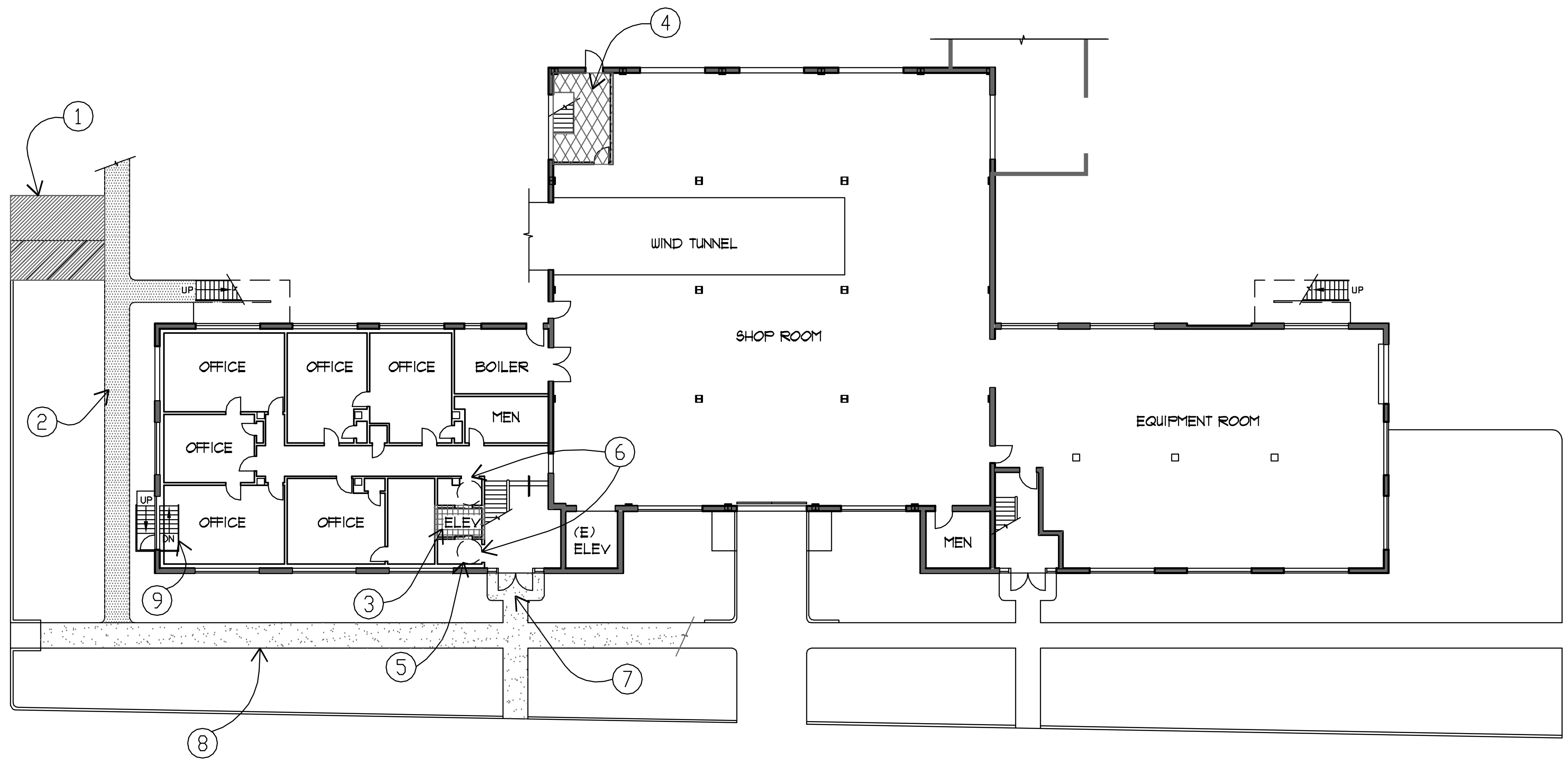
Appendix 2. Existing Floor Plans & Rehabilitation



N-226 FIRST FLOOR PLAN

REHABILITATION LEGEND & KEY NOTES

1. SUGGESTED AREA FOR NEW VAN ACCESSIBLE PARKING AND DEPRESSED SIDEWALK
2. SUGGESTED AREA FOR ACCESSIBLE PATH FROM PARKING AREA
3. SUGGESTED LOCATION FOR NEW ELEVATOR - FRONT AND REAR OPENING / 90"x70" CLR INSIDE - AND ELEVATOR LOBBIES
4. PROVIDE EXIT STAIR ENCLOSURE TO MAINTAIN EXIT CONTINUITY
5. 5' DIAMETER, TYP. (REQUIRED CLEARANCE)
6. PROVIDE NEW OPENING IN THE WALL FOR LOBBY
7. PROVIDE ACCESSIBLE ENTRY TO THE BUILDING
8. EXISTING ACCESSIBLE PATH
9. PROVIDE EXIT STAIR AND LANDING AT EMERGENCY EXIT

GENERAL NOTES

1. NOT ALL KEY NOTES AAPPEAR ON ALL SHEETS, KEY NOTES MAY APPLY TO ONE FLOOR ONLY.
2. REFER TO SECTION VIII. "CODE EVALUATIONS AND RECOMMENDATIONS" FOR DETAILED DESCRIPTION.

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EXISTING PLANS & REHABILITATION

32 Ø 32
1/32" = 1'-Ø"

BUILDING N226
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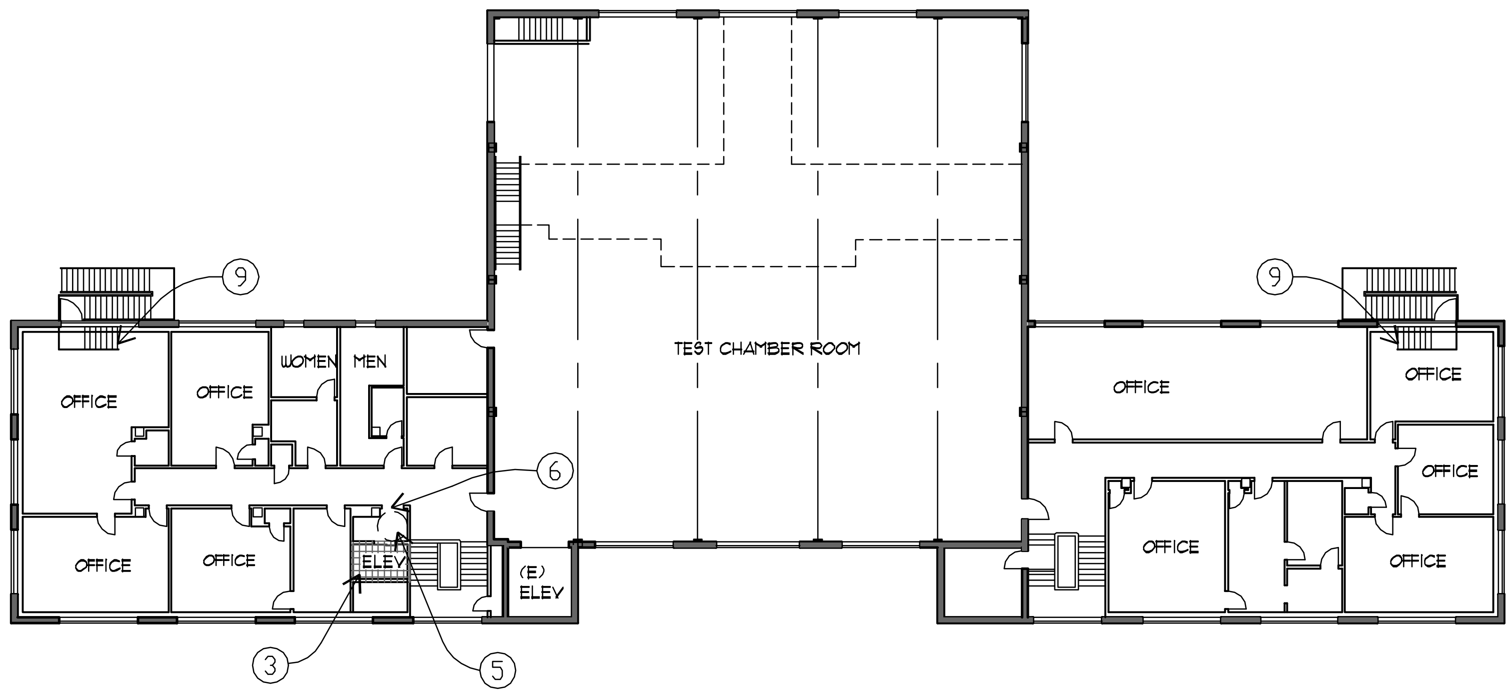
Sunnyvale, CA
October, 2007

N



N-226 SECOND FLOOR PLAN

REHABILITATION LEGEND & KEY NOTES

1. SUGGESTED AREA FOR NEW VAN ACCESSIBLE PARKING AND DEPRESSED SIDEWALK
2. SUGGESTED AREA FOR ACCESSIBLE PATH FROM PARKING AREA
3. SUGGESTED LOCATION FOR NEW ELEVATOR - FRONT AND REAR OPENING / 90"x70" CLR INSIDE - AND ELEVATOR LOBBIES
4. PROVIDE EXIT STAIR ENCLOSURE TO MAINTAIN EXIT CONTINUITY
5. 5' DIAMETER, TYP. (REQUIRED CLEARANCE)
6. PROVIDE NEW OPENING IN THE WALL FOR LOBBY
7. PROVIDE ACCESSIBLE ENTRY TO THE BUILDING
8. EXISTING ACCESSIBLE PATH
9. PROVIDE EXIT STAIR AND LANDING AT EMERGENCY EXIT

GENERAL NOTES

1. NOT ALL KEY NOTES AAPPEAR ON ALL SHEETS, KEY NOTES MAY APPLY TO ONE FLOOR ONLY.
2. REFER TO SECTION VIII. "CODE EVALUATIONS AND RECOMMENDATIONS" FOR DETAILED DESCRIPTION.

ARCHITECTURAL RESOURCES GROUP
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EXISTING PLANS & REHABILITATION

32 Ø 32
1/32" = 1'-Ø"

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October, 2007

N

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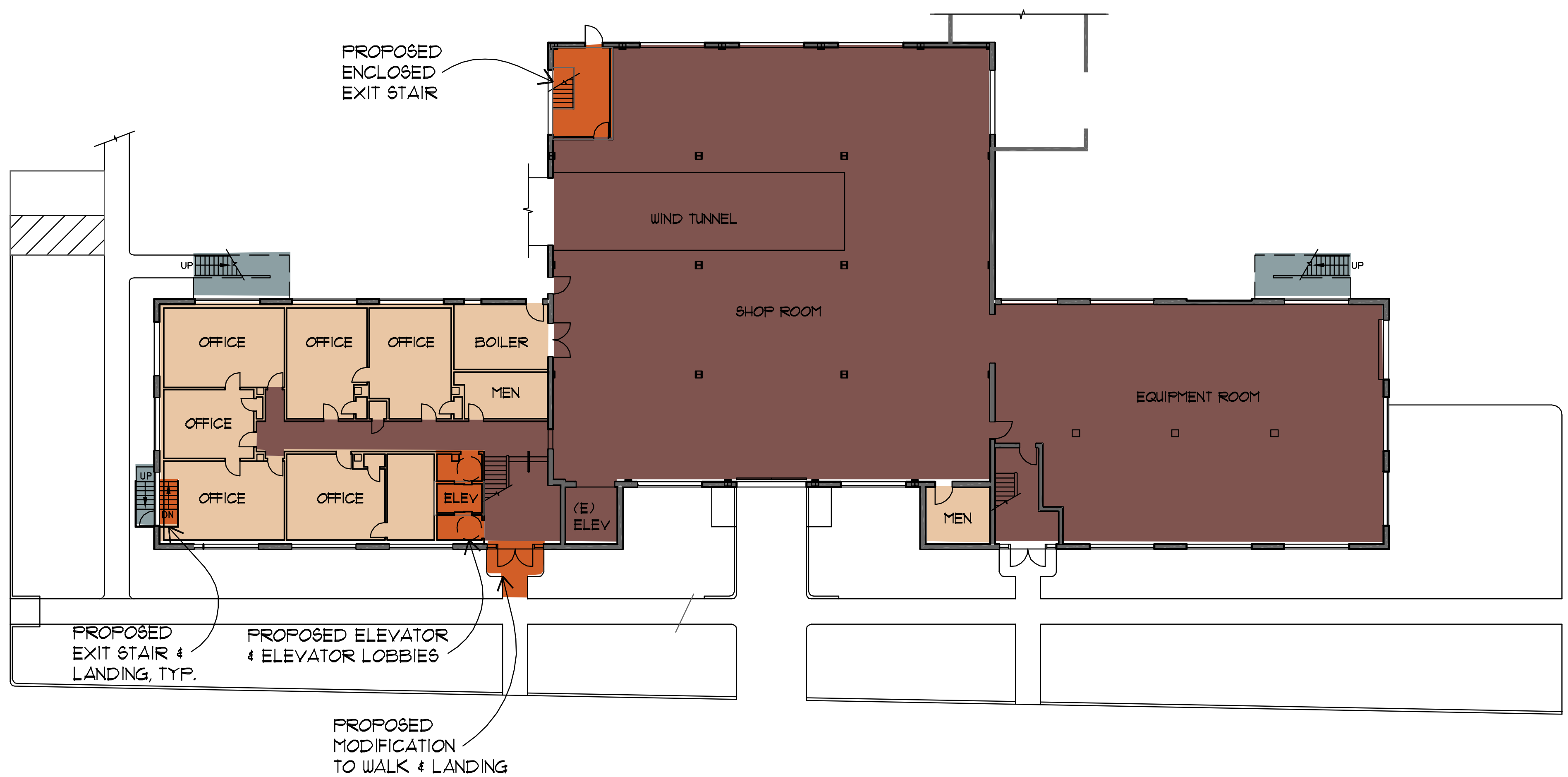
Appendix 3. Character-Defining Significance Diagrams



N-226 FIRST FLOOR PLAN

GENERAL NOTES

1. THESE DIAGRAMS ARE INTENDED TO SHOW THE PRINCIPAL CHARACTER-DEFINING FEATURES, NOT SPECIFIC COMPONENTS.

2. FOR A MATRIX OF SIGNIFICANCE RATINGS FOR INDIVIDUAL BUILDING COMPONENTS, REFER TO APPENDIX I. "HISTORIC CHARACTER-DEFINING FEATURES".

CHARACTER-DEFINING SIGNIFICANCE DIAGRAMS LEGEND

- SIGNIFICANT FEATURE
- CONTRIBUTING FEATURE
- TERTIARY FEATURE
- NON-CONTRIBUTING FEATURE
- NEW CONSTRUCTION - PROPOSED

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HISTORIC CHARACTER-DEFINING SIGNIFICANCE DIAGRAMS - PLANS

32 0 32
1/32" = 1'-0"

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October, 2007

N

N-226 SECOND FLOOR PLAN

GENERAL NOTES

1. THESE DIAGRAMS ARE INTENDED TO SHOW THE PRINCIPAL CHARACTER-DEFINING FEATURES, NOT SPECIFIC COMPONENTS.

2. FOR A MATRIX OF SIGNIFICANCE RATINGS FOR INDIVIDUAL BUILDING COMPONENTS, REFER TO APPENDIX I. "HISTORIC CHARACTER-DEFINING FEATURES".

CHARACTER-DEFINING SIGNIFICANCE DIAGRAMS LEGEND

- SIGNIFICANT FEATURE
- CONTRIBUTING FEATURE
- TERTIARY FEATURE
- NON-CONTRIBUTING FEATURE
- NEW CONSTRUCTION - PROPOSED

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HISTORIC CHARACTER-DEFINING SIGNIFICANCE DIAGRAMS - PLANS

32 0 32 64
1/32" = 1'-0"

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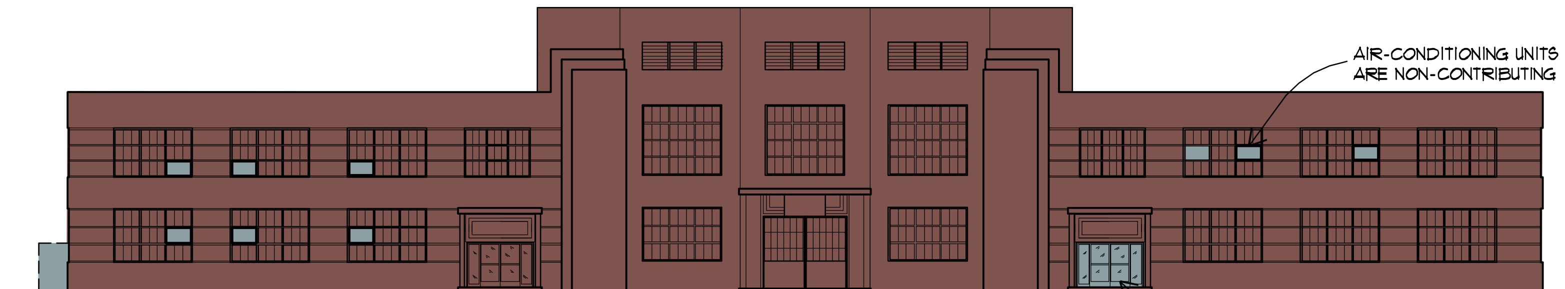
N



N-226 EAST ELEVATION

N-226 SOUTH ELEVATION

GENERAL NOTES

1. THESE DIAGRAMS ARE INTENDED TO SHOW THE PRINCIPAL CHARACTER-DEFINING FEATURES, NOT SPECIFIC COMPONENTS.

2. FOR A MATRIX OF SIGNIFICANCE RATINGS FOR INDIVIDUAL BUILDING COMPONENTS, REFER TO APPENDIX I. "HISTORIC CHARACTER-DEFINING FEATURES".

CHARACTER-DEFINING SIGNIFICANCE DIAGRAMS LEGEND

- SIGNIFICANT FEATURE
- CONTRIBUTING FEATURE
- TERTIARY FEATURE
- NON-CONTRIBUTING FEATURE
- NEW CONSTRUCTION - PROPOSED

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HISTORIC CHARACTER-DEFINING SIGNIFICANCE DIAGRAMS - ELEVATIONS

32 0 32 64
1/32" = 1'-0"

BUILDING N226
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OCTOBER, 2007

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Building 226 Reuse Guidelines

Appendix 4. Historic Aerial Photographs

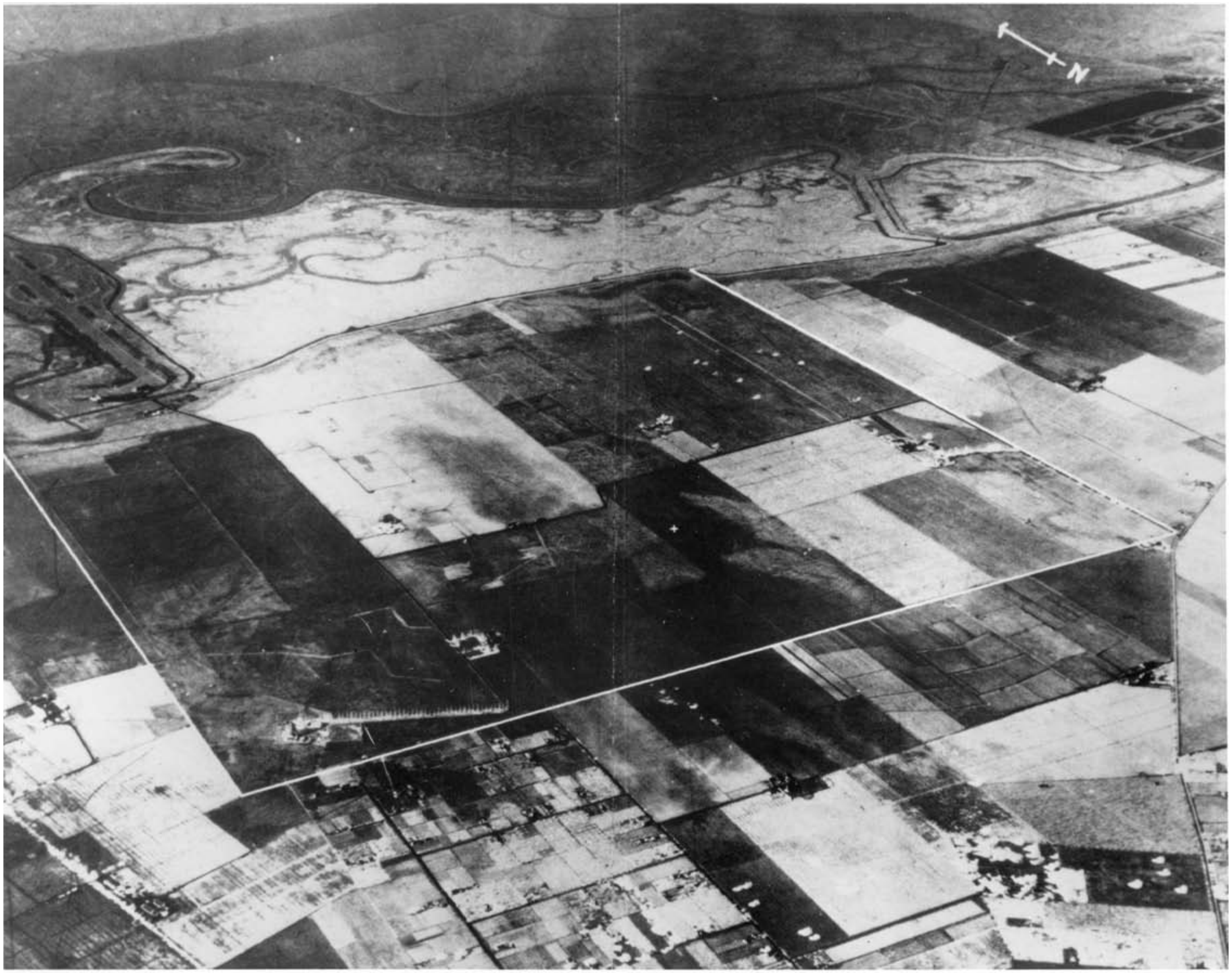

Figure 1: 1930 aerial photograph of future Moffett Field

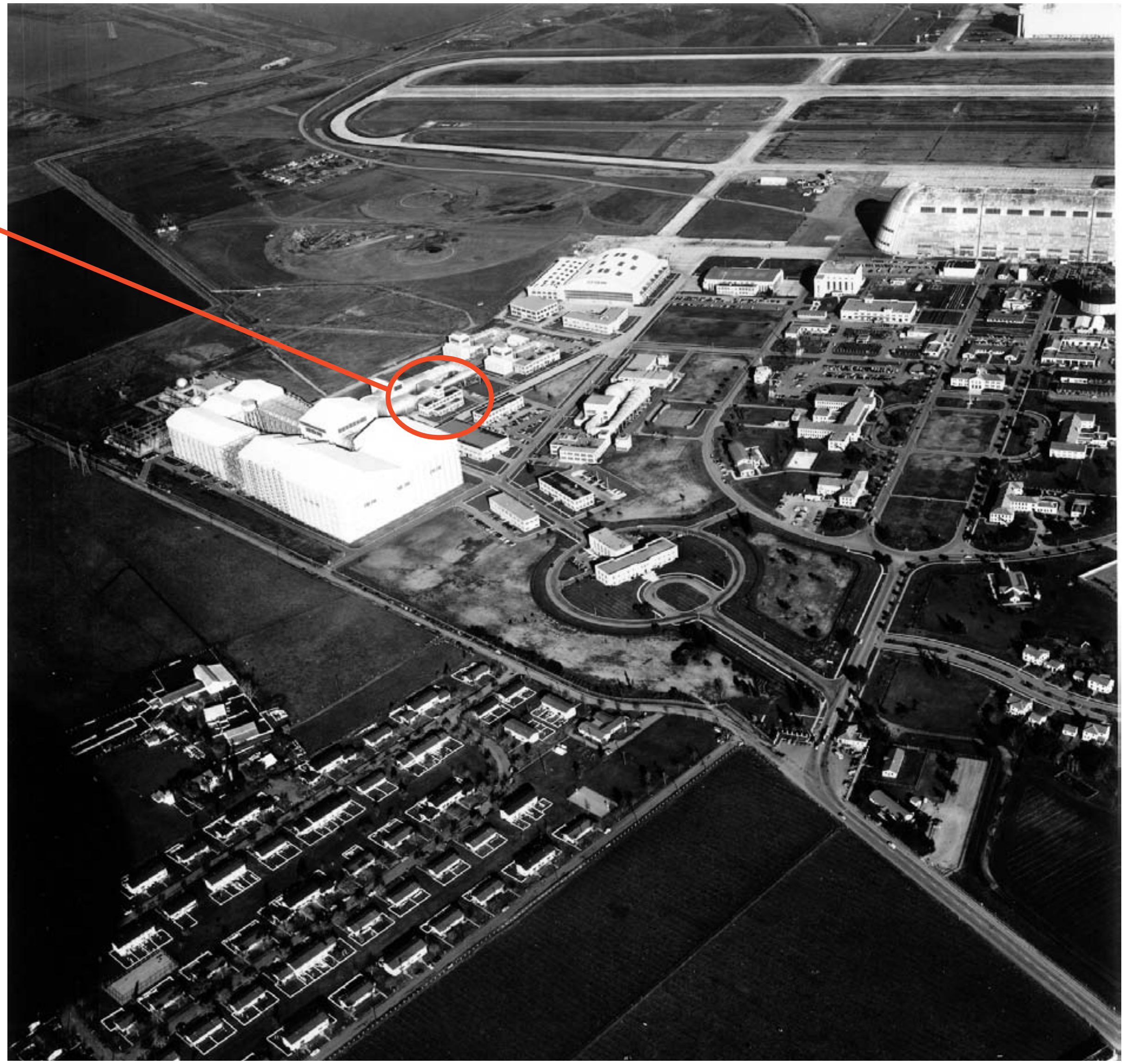

Figure 2: 1944 aerial of Moffett Field

Figure 3: 1982 aerial of Moffett Field

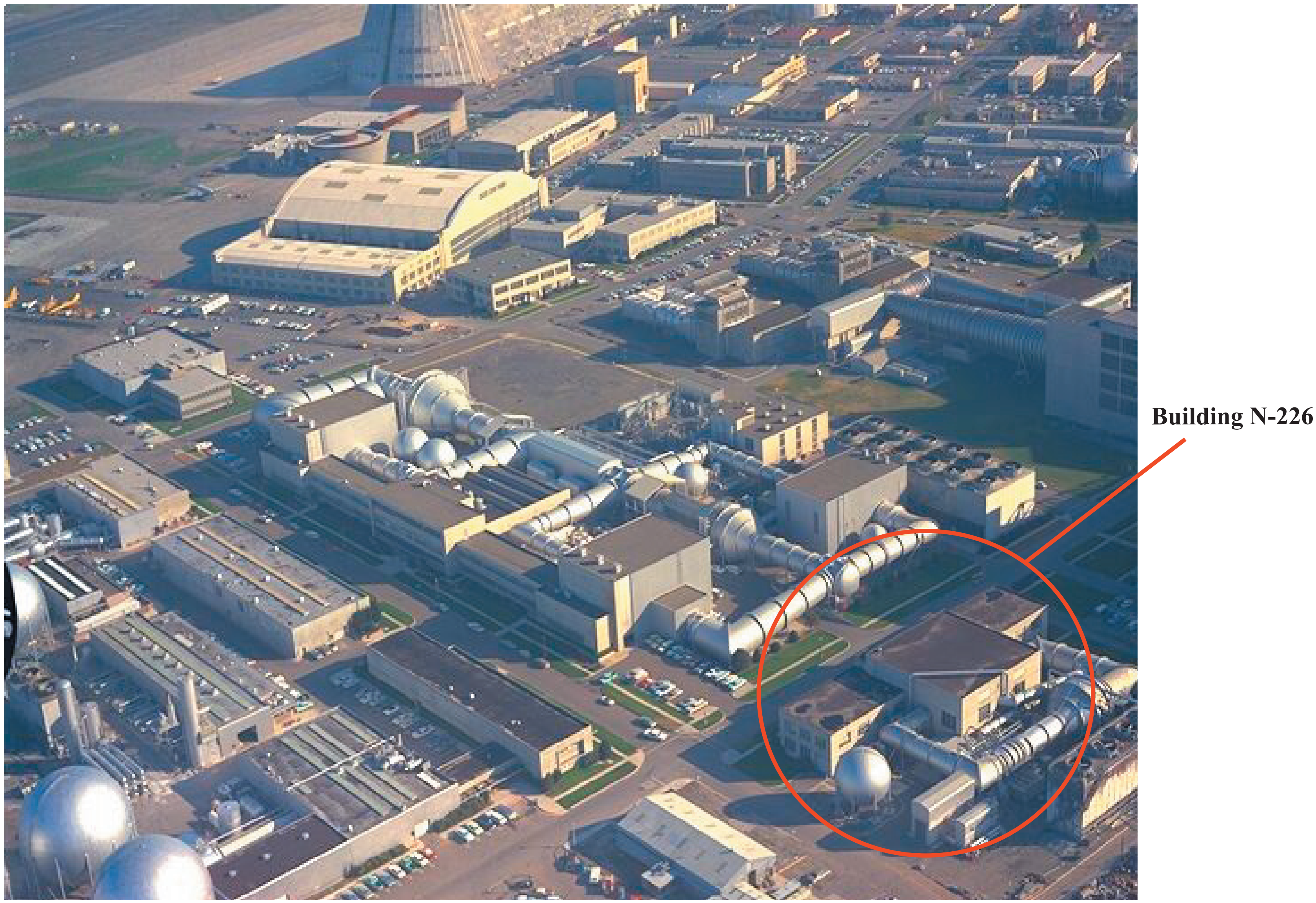

Figure 4: 1967 aerial showing Building N-226, bottom right

Figure 5: 1973 aerial showing Bulding N-226, center

Building N-226

Figure 6: 1989 aerial showing Building N-226, bottom left

Building N-226

Figure 7: 1984 aerial showing Building N-226, bottom right

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Appendix 5. Current Conditions Photographs (2006)

Figure 8. East façade

Figure 9. East proposed accessible entry

Figure 10. East entries and restroom tower with glass block band windows

Figure 11. East 6 by 6 Foot Wind Tunnel entry

Figure 12. North elevation

Figure 13. West elevation of north wing

Figure 14. West elevation

Figure 15. 3-lite doors with cantilevered awning at west façade

Figure 16. South elevation

Figure 17. Interior shop room

Figure 18. Interior shop room

Figure 19. Interior view of the east center door

Figure 20. Interior equipment room

Figure 21. Interior Test Chamber room

Figure 22. Test Chamber Room looking north east

Figure 23. Test chamber room looking north

Figure 24. Test chamber room ceiling

Figure 25. Stair inside test chamber room

Figure 26. Office room interior and exit door at the north-west corner

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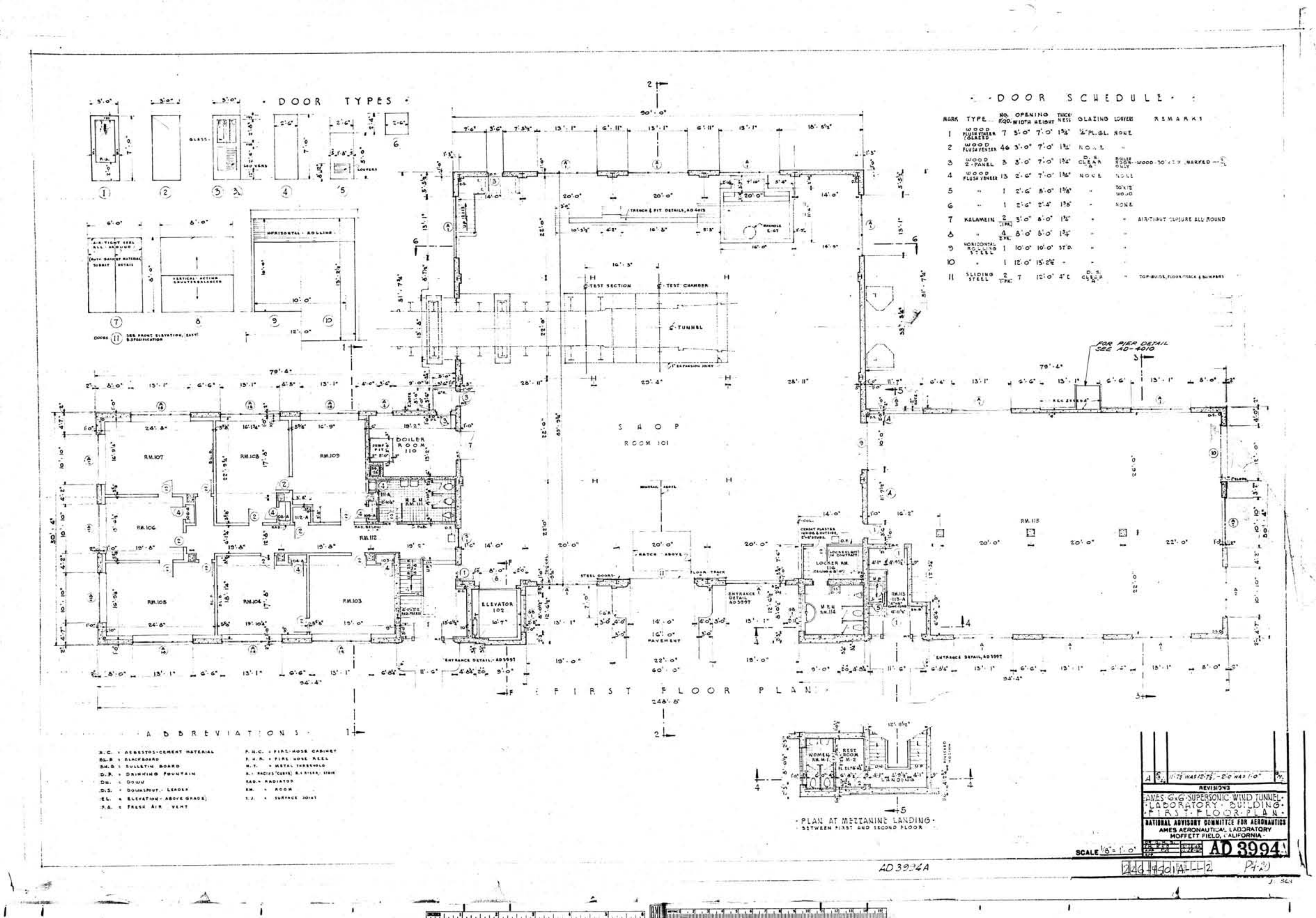
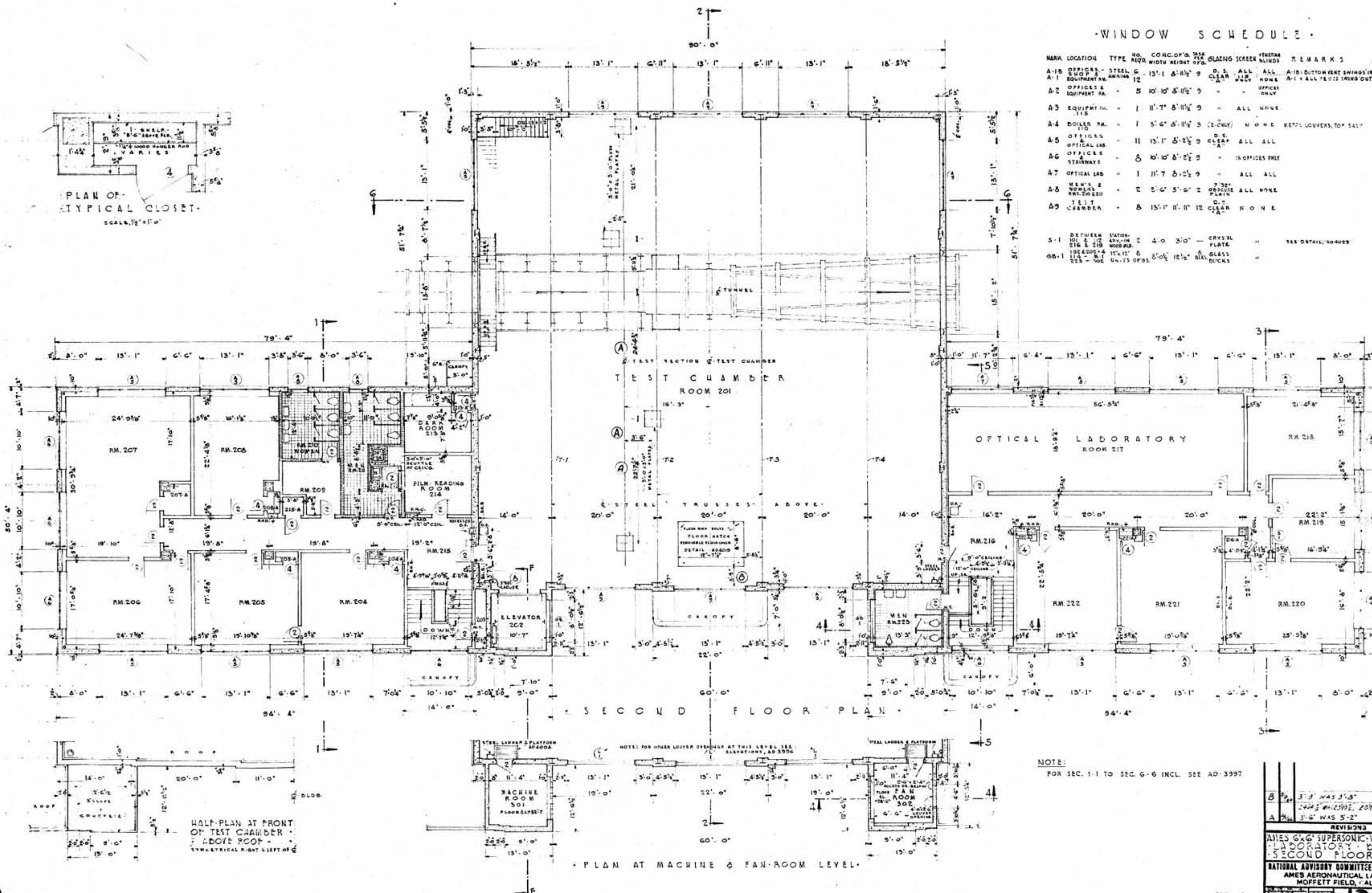
Building 226 Reuse Guidelines

Appendix 6. Construction Plans


DOOR TYPES
DOOR SCHEDULE
FOR PIER DETAIL SEE AD-4010
SHOP
ROOM 101
BOILER ROOM 110
ELEVATOR 102
LOCKER RM. 116
FIRST FLOOR PLAN
ABBREVIATIONS
PLAN AT MEZZANINE LANDING
BETWEEN FIRST AND SECOND FLOOR
REVISIONS
AMES 6x6 SUPERSONIC WIND TUNNEL
LABORATORY BUILDING
FIRST FLOOR PLAN
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
AMES AERONAUTICAL LABORATORY
MOFFETT FIELD, CALIFORNIA
SCALE 1/8" = 1'-0"
AD 3994
AD 3994A



·WINDOW SCHEDULE·

MARK	LOCATION	TYPE	NO. REQ'D.	CONC. OP'G. WIDTH	CONC. OP'G. HEIGHT	SASH PER OP'G.	GLAZING	SCREEN	VENETIAN BLINDS	REMARKS
A-1B / A-1	OFFICES - SHOP & EQUIPMENT RM.	STEEL, AWNING	6 / 12	13'-1	8'-11½"	9	D. S. CLEAR "A"	ALL / 119 ONLY	ALL / NONE	A-1B: BOTTOM VENT SWINGS IN. A-1: ALL VENTS SWING OUT.
A-2	OFFICES & EQUIPMENT RM.	"	5	10'-10"	8'-11½"	9	"	-	OFFICES ONLY	
A-3	EQUIPM'T RM. 115	"	1	11'-7"	8'-11½"	9	"	ALL	NONE	
A-4	BOILER RM. 110	"	1	3'-6"	8'-11½"	3 (2-ONLY)	NONE			METAL LOUVERS, TOP SASH
A-5	OFFICES & OPTICAL LAB.	"	11	13'-1"	8'-2½"	9	D. S. CLEAR "A"	ALL	ALL	
A-6	OFFICES & STAIRWAYS	"	8	10'-10"	8'-2½"	9	"	IN OFFICES ONLY		
A-7	OPTICAL LAB	"	1	11'-7	8'-2½	9	"	ALL	ALL	
A-8	MEN'S & WOMEN'S RMS. 210 & 211	"	2	2'-6"	5'-6"	2	7/32" OBSCURE PLAIN	ALL	NONE	
A-9	TEST CHAMBER	"	8	13'-1"	11'-11"	12	D. S. CLEAR "A"	NONE		
S-1	BETWEEN 101 & 112, 216 & 219	STATION-ARY, IN WOOD MLD.	2	4'-0	3'-0"	—	CRYSTAL PLATE		"	SEE DETAIL, AD4023
GB-1	102 & 202-4, 114-M-1, 225-302	12"x12" UNITS OP'GS.	8	8'-0½	12½"	6 BLKS.	GLASS BLOCKS		"	

NOTE:
FOR SEC. 1-1 TO SEC. G-6 INCL. SEE AD-3997

B	5/8/44	3'-9" WAS 3'-8"	
		24'-2½" WAS 23'-10½", 22'-9½" WAS 23'-1¼"	NEW
A	7/1/44	3'-6" WAS 5'-2"	RRB

REVISIONS

AMES 6'x6' SUPERSONIC WIND TUNNEL·
·LABORATORY · BUILDING·
·SECOND FLOOR PLAN·

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
AMES AERONAUTICAL LABORATORY
MOFFETT FIELD, CALIFORNIA

ABBREVIATIONS - AD 3994

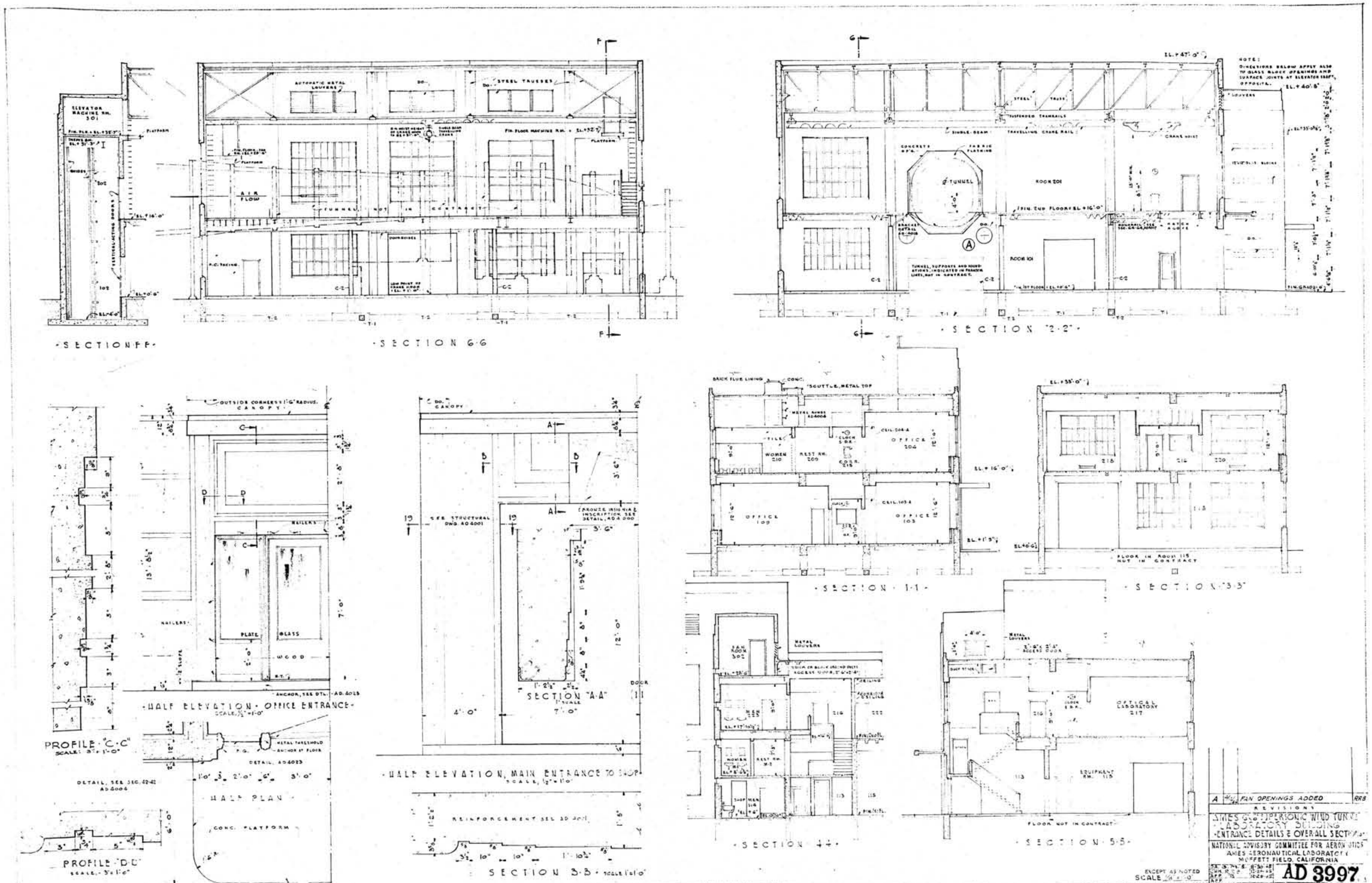
SCALE 1/8" = 1'-0"

AD 3995B

AD 3995B

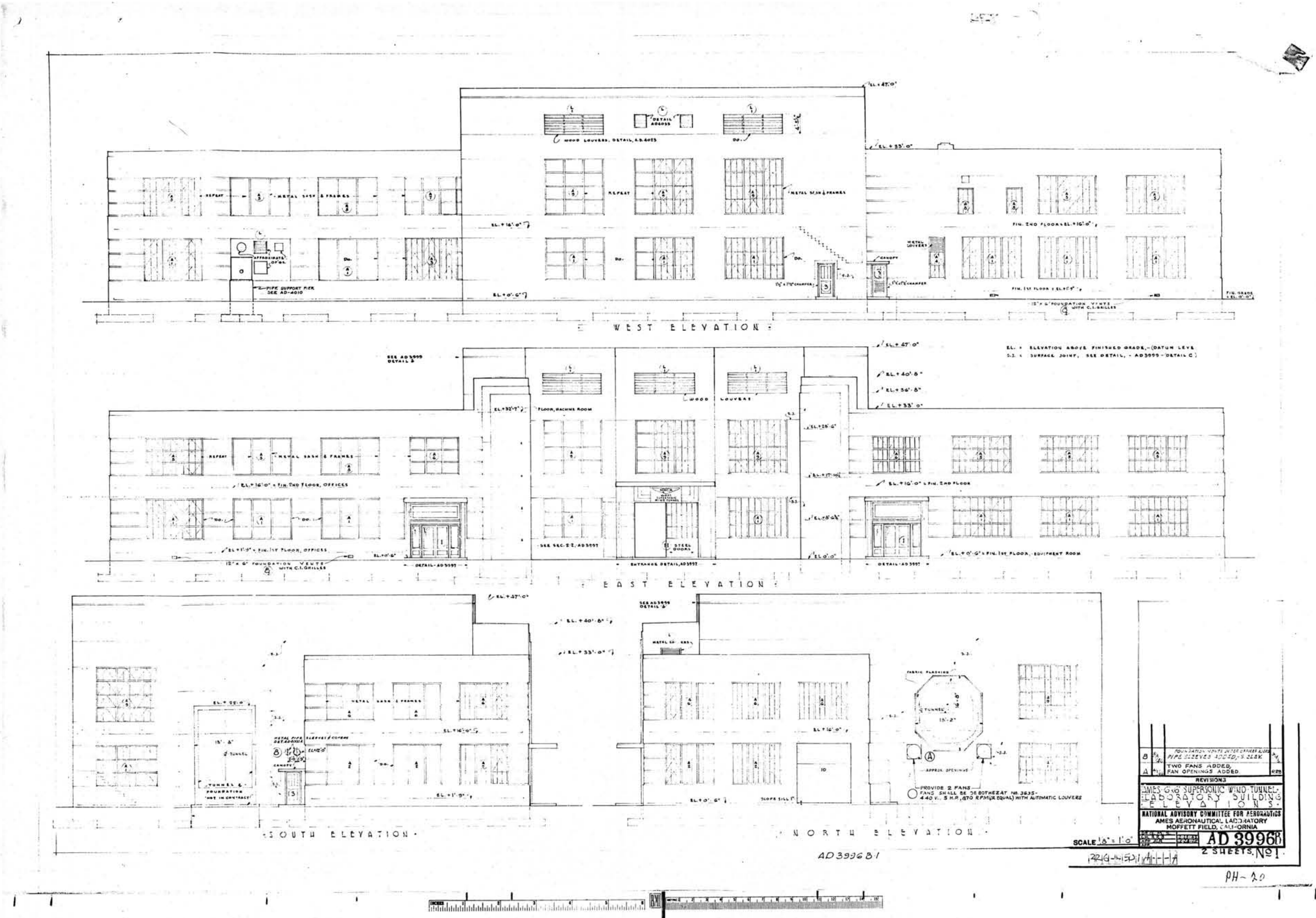
226-1454/4---3

PH C-0


SECTION F-F
SECTION 6-6
SECTION "2-2"
SECTION 1-1
SECTION 3-3
SECTION 4-4
SECTION 5-5
PROFILE "C-C"
PROFILE "D-D"
HALF ELEVATION - OFFICE ENTRANCE
HALF PLAN
SECTION "A-A"
HALF ELEVATION, MAIN ENTRANCE TO SHOP
SECTION B-B
A FAN OPENINGS ADDED
REVISIONS
AMES 6x6 SUPERSONIC WIND TUNNEL LABORATORY BUILDING
ENTRANCE DETAILS & OVERALL SECTIONS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
AMES AERONAUTICAL LABORATORY
MOFFETT FIELD, CALIFORNIA
EXCEPT AS NOTED
AD 3997

AD 3997

PH-20


WEST ELEVATION
EAST ELEVATION
SOUTH ELEVATION
NORTH ELEVATION
EL. = ELEVATION ABOVE FINISHED GRADE, - (DATUM LEVEL)
S.J. = SURFACE JOINT, SEE DETAIL, - AD3999 - DETAIL C
WOOD LOUVERS
METAL SASH & FRAMES
2-PIPE SUPPORT PIER SEE AD-4010
12" x 6" FOUNDATION VENTS WITH C.I. GRILLES
STEEL DOORS
PROVIDE 2 FANS
4-40 V., 5 H.P. (870 RPM OR EQUAL) WITH AUTOMATIC LOUVERS
B FOUNDATION VENTS UNDER OFFICES ADDED, PIPE SLEEVES ADDED, - S. ELEV.
A TWO FANS ADDED, FAN OPENINGS ADDED RRB
REVISIONS
AMES 6x6 SUPERSONIC WIND TUNNEL
LABORATORY BUILDING
ELEVATIONS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
AMES AERONAUTICAL LABORATORY
MOFFETT FIELD, CALIFORNIA
SCALE 1/8" = 1'-0"
AD 3996B
2 SHEETS. No 1.
AD 3996 B-1
PH-20

NASA Ames Research Center
Building 226 Reuse Guidelines

Appendix 7. NRHP Nomination

SETTING

Situated at the southern end of San Francisco Bay, the National Aeronautics and Space Administration (NASA) Ames Research Center borders the towns of Sunnyvale and Mountain View, near the heart of Silicon Valley. The Ames facility occupies approximately 430 acres of land and hosts a number of other federal, civilian, and military resident agencies on the adjoining 1,500-acre former United States Naval Air Station, now known as Moffett Field.

The 6 x 6 Supersonic Wind Tunnel Building is located on the western edge of Moffett Field, directly north of the 40 x 80 Wind Tunnel Structure and the 80 x 120 leg. Identified as Building N-226, the 6 x 6 Supersonic Wind Tunnel Building is located on the southwest corner of the intersection of Boyd Road and De France Avenue. The two-story building with mezzanine contains 33,383 gross square feet. Of that amount, the first floor contains 14,839 square feet of usable floor space and the second floor contains 11,824 square feet of usable floor space.

HISTORIC APPEARANCE OF THE 6 X 6 SUPERSONIC WIND TUNNEL BUILDING

Constructed between 1946 and 1948, historic photographs of the 6 x 6 Supersonic Wind Tunnel Building reveal that the configuration and exterior building materials have remained unchanged from the time of original construction. Although the setting of the building has changed, the types of changes that have occurred are consistent with the original uses employed at the site. The addition of other Ames buildings and structures in close proximity to the Administration Building has enhanced the feel of the building and do not detract from the historic appearance of the building or its surrounding environment.

Interior Space

The original interior configuration of the 6 x 6 Supersonic Wind Tunnel Laboratory Building ground floor consisted of office and meeting rooms (identified as Rooms 103 through 109) on the southern end, one large open space (identified as Room 115) on the northern end, and a central Shop section where models were produced for testing in the 6 x 6. Identified as Room 101, the Shop measured approximately 102’ x 90’ and contained wind tunnel machinery and equipment. Vacuum pumps and compressors for the wind tunnel were also located in this section.

The second floor originally consisted of office and meeting rooms on the southern end (identified as Rooms 204 through 208), additional rooms on the northern end (identified as Rooms 218 through 222), as well as the

Optical Laboratory (identified as Room 217). The center portion of the second floor, the test section, contained the actual test chamber of the 6 x 6 Supersonic Wind Tunnel, from which the tunnel's name is derived. A majority of the interior portions of the tunnel were located in the second floor test section, and along with the actual tunnel and test chamber, the second floor also featured a system of steel trusses on which a moveable bridge crane and hoist system operated. The crane was used to hoist aerodynamic models from the first floor model shop up through an opening in the ceiling and then over and down into the 6 x 6 Foot test chamber of the wind tunnel.

Also included in the second floor test chamber was the Schlieren photography equipment box, located on the east interior wall. The Schlieren system is an "optical high-speed photography imaging system used for visualization of supersonic shock wave patterns. In addition to the equipment box, the wind tunnel test chamber contained a set of Schlieren disks that the laser beam passed through in order to photograph the effects of the airflow and shock patterns on the models.

The two windows weighed more than one ton each and measured six inches thick, and fifty-two inches in diameter. According to one observers account:

> "…The most interesting thing to me about the 6 x 6 foot wind tunnel were the side windows used to observe the behavior of the models being tested. The two windows are the largest optically ground glass lenses in the world. The glass was poured by the Corning Glass Company and ground by Tinsley Company in Oakland. The guide told me they cost $50,000.00 each."[1]

MODIFICATION HISTORY OF THE 6 X 6 SUPERSONIC WIND TUNNEL BUILDING

Historic research has revealed that while the 6 x 6 was still in use, the wind tunnel building underwent few alterations and or modifications. Early on in the life of the wind tunnel researchers began to discover that the tunnel could not obtain data in the transonic ranges. This discovery prompted Ames staff member Charles Hall to explore modifications to the original design of the 6 x 6 wind tunnel. The alterations to the tunnel were completed in 1955 and the exact specifications of these alterations are unknown.

After the 6 x 6 test section was decommissioned in the late 1980s, the northern portion of the building's second floor was remodeled for use as the Ames Aerospace Encounter, which opened in October 1991. The Ames

[1] "Work At Ames Lab. Proves Eye-Opener," *Daily Palo Alto Times*, July 11, 1950.

Aerospace Encounter is a math and science based educational program that teaches 4th, 5th, and 6th grade students about science and technology in relation to space and aeronautics. The actual wind tunnel and related equipment is extant and is incorporated into the educational program. The first floor is currently used as a storage facility and most likely houses other miscellaneous uses. The southern portion of the second floor is used for office and meeting spaces. This current use is consistent with the original use. Overall, in form, materials and details, the 6 x 6 Supersonic Wind Tunnel Building retains its historic appearance.

CURRENT APPEARANCE OF THE 6 X 6 SUPERSONIC WIND TUNNEL BUILDING
The 6 x 6 Supersonic Wind Tunnel Laboratory Building was designed in a stripped classical style with an observable influence by the International and Streamline Moderne styles. The two-story, flat roofed building has a general rectangular, or modified T-shaped plan. The symmetrically designed building is divided into three sections with a center section flanked by a wing on each side. Each wing measures 79’ 4” in length by 50’ 4” in width (depth of wing portion) and the center section is 90’ long by 102’ deep.

The front, east elevation features a central slightly recessed façade flanked on each side by the building’s wing. The central portion of the building is taller than the two wings and measures approximately 47’ tall. The recessed facade contains double doors that lead to the ground floor model shop space that now serves several miscellaneous uses. Above the entrance is a pre-cast mitred concrete panel that is now partially covered with signage displaying “NASA 6 x 6 Foot Supersonic Wind Tunnel.” The original pre-cast panel most likely displayed lettering reading “NACA” indicating the building was originally constructed during the administration of the National Advisory Committee on Aeronautics (NACA). Above the double doors is a cantilevered concrete canopy featuring rounded corner edges indicative of the Streamline style. The central facade contains eight windows; two on the ground floor, three on the second floor, and, three rectangular shaped louvered windows above.

The two wings are horizontally divided into three sections by alternating bands of smooth concrete separated horizontally by rusticated concrete wall portions. A large metal hopper window with a nine-pane sash separates each rusticated wall section.

The exterior body of the wind tunnel and its related machinery obstructs view of the building’s rear, west elevation. This includes the cooling coils, the compressor and the drive motors. In addition, located directly west of the building is the original wind tunnel cooling tower. In close proximity to the cooling tower is the spherical-shaped dry storage air tank.

INTEGRITY

Both the interior and exterior portions of the Ames Aeronautical Laboratory 6 x 6 Supersonic Wind Tunnel Building retain a good degree of integrity according to the seven aspects of integrity defined by National Register Bulletin 36: location, design, setting, materials workmanship, feeling, and association. The building remains at its original historic location. The building's original stripped classical design with Streamline Moderne elements remains intact. The current setting of a research facility with various buildings and structures surrounding the building is consistent with the original setting of the 6 x 6 Wind Tunnel Building. The historic materials originally employed on the exterior portions of the building are extant today. The workmanship is still evident in the exterior and interior portions of the building, and the feeling or historic sense of the 6 x 6 Wind Tunnel building is articulated through its form and modern, stripped classical details and through its current use. Moreover, the original wind tunnel and its components are completely intact and extant on the site.

OMB No. 1024-0018

SUMMARY OF SIGNIFICANCE

The Ames 6 x 6 Supersonic Wind Tunnel Building is significant at the national level under National Register Criterion A for its direct association with supersonic flight research and for its use as supersonic wind tunnel testing facility.

The 6 x 6 Supersonic Wind Tunnel Building is eligible for inclusion on the National Register of Historic Places at a national level of significance under Criterion A (event) in the areas of aeronautics and space exploration (1948-1988) for its association with important events in the areas of supersonic research and development. In addition, as an exceptional engineering accomplishment in the context of wind tunnel construction, the 6 x 6 Supersonic Wind Tunnel is also eligible for inclusion on the National Register under Criterion C.

HISTORICAL BACKGROUND

The NASA Ames Research Center was initially founded on December 20, 1939, as an aircraft research laboratory by the National Advisory Committee on Aeronautics (NACA), the forerunner of NASA. Ames has played a pioneering role in science and technology over six decades. The center was named for Dr. Joseph S. Ames, NACA Chairperson from 1927 to 1939. Ames was NACA's second laboratory, established after the Langley facility in Hampton, Virginia. In 1958, Ames became part of the National Aeronautics and Space Administration (NASA). Since its inception, Ames researchers have broken new ground in all flight regimes--the subsonic, transonic, supersonic, and hypersonic--using a collection of wind tunnels and research aircraft, the sophistication of which has increased over time. Ames has evolved into a diverse and sophisticated research campus of buildings influenced by the clean lines and materials of the International style, fused with elements of the Streamline Moderne, both styles are very well suited to industrial type buildings.

Ames specializes in research geared toward creating new knowledge and new technology, encompassing the fields of supercomputing, networking, numerical computing software, artificial intelligence, and human factors to enable advances in aeronautics and space. In aeronautics, Ames is the leading NASA agency in airspace operations systems, including air traffic control and human factors, and the lead center for rotorcraft technology. Ames also has major responsibilities in the creation of design and development process tools and wind tunnel testing. Ames houses one of the world's largest collections of wind tunnels and simulation facilities.

According to the NASA history publication, the *Wind Tunnels Of NASA*, the need for supersonic wind tunnels emerged out of a theory proposed by Langley scientist, Robert T. Jones, who hypothesized that the sound barrier would be pierced more easily if an aircraft's wings were swept back. The first supersonic test was conducted in 1945 in the Langley 9-inch supersonic tunnel.[1]

While testing was conducted at Langley, the Ames staff was also pondering supersonic wind tunnel design. In May 1944 the Ames staff presented plans to NACA for the design and construction of a supersonic wind tunnel large enough for a person to work in. Prior to this time, the supersonic wind tunnels that had been constructed were small scale, and at Ames this consisted of the 1 by 3 foot supersonic wind tunnel and the 8-inch by 8-inch supersonic wind tunnel that served as a prototype of the 6 x 6.[2] Claiming lack of funds, the NASA administrators denied the Ames request to build a larger supersonic wind tunnel. Shortly after the Ames request was denied, Navy engineers approached NACA for assistance in building a supersonic wind tunnel. Seeing the need at Ames, and the Navy's availability of funds, the two agencies agreed to construct a new supersonic wind tunnel with a test chamber large enough for a person to work inside.[3]

Construction of the Ames Aeronautical Laboratory 6 x 6 Foot Supersonic Wind Tunnel Building began after the Navy had transferred the project funds to the Ames Aeronautical Laboratory in January 1945 and by June 16, 1948, the 6 x 6 began operations.

PERIOD OF SIGNIFICANCE

The Ames Administration Building is significant from 1948, upon completion of construction, through c.1988, when the wind tunnel was decommissioned. During this forty-year period, significant supersonic flight research discoveries occurred and designs for supersonic craft and missiles were created based on specifications derived from testing in the 6 x 6. This determination means that a majority of the events have taken place within the past fifty years. These events are considered exceptional in national aviation and aeronautics history.

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[1] http://www.hq.nasa.gov/office/pao/History/SP-440/ch5-3.htm

[2] *Atmosphere of Freedom*, 27-34.

[3] *Ibid*.

DISCUSSION OF SIGNIFICANCE

Criterion A:

The 6 x 6 Supersonic Wind Tunnel is significant under National Register Criterion A in the area of aeronautics and space exploration due to its use as a supersonic testing and research facility where many significant discoveries were made that helped man fly at speeds above Mach 1.

Upon completion of construction in 1948, the Ames 6 x 6 was used to test every major jet aircraft and guided missile of the 1950s. This included drag reduction, stability and control, and inlet design – all at varying mach numbers.[4] The 6 x 6 was able to test models in the subsonic range, supersonic range, and transonic range producing speeds from Mach 0.6 to Mach 2.2. After other supersonic wind tunnels were constructed at Ames, namely the Unitary Plan 9 x 7 Wind Tunnel, the 6 x 6 was then used for basic research in the areas of inlet design for supersonic speeds, canard-type controls, vortex flows, and conical cambers.[5]

Criterion C:

The 6 x 6 Supersonic Wind Tunnel is significant under Criterion C because it is considered to be an exceptionally important engineering accomplishment in the context of wind tunnel construction.

Originally constructed in 1948, the design of the 6 x 6 Supersonic Wind Tunnel differed from other wind tunnels at Ames in that its design responded to the problems identified with conventional supersonic wind tunnel design. Conventional supersonic wind tunnels had to shut down and change the nozzle contours every time tests were to be run at different Mach numbers.[6] The 6 x 6 diverged in that it employed a design that enabled the tunnel to be continuously operated while the nozzle contour was modified in order to accommodate various Mach number tests. Originally conceived by Ames researcher and Director (1965-1969), H. Julian Allen, the 6 x 6 design consisted of a one fixed nozzle wall with the opposite nozzle wall sliding axially. The fixed and sliding wall design resulted in a changing contour, which was necessary in order to test for a range of Mach numbers. "Thus, the tunnel is asymmetric but variable. The key to the whole idea was the recognition that unique contours could be found, using one fixed wall and one moving wall, that would provide uniform supersonic velocities over a range of Mach numbers. In the 6 x 6 this range was Mach 1.3 to Mach 1.8. Later

[4] *Atmosphere of Freedom*, 33.
[5] *Ibid.*, 33.
[6] http://www.hq.nasa.gov/office/pao/History/SP-440/ch5-3.htm

wind tunnels, notably the Ames 9 x 7-foot Unitary Plan Wind tunnel Mach 1.5 to Mach 2), and the Langley Unitary Plan Tunnel (Mach 1.5 to Mach 4.6) employed this novel concept."[7]

The Ames Aeronautical Laboratory 6 x 6 Supersonic Wind Tunnel was the first to incorporate the revolutionary fixed and moving wall design conceived by H. Julian Allen at Ames. It served as a pioneering example of a supersonic wind tunnel constructed large enough to accommodate a person inside the test chamber and moreover, it was the first supersonic wind tunnel to have the ability to continuously operate while changing the nozzle contour in order to test for different Mach numbers.

[7] http://www.hq.nasa.gov/office/pao/History/SP-440/ch5-3.htm

OMB No. 1024-0018

BIBLIOGRAPHY

"Ames Celebrates 40th Anniversary," *The Astrogram*, V. XXII, No. 6, December 27, 1979

"Ames Plans Sixth New Wind Tunnel," *San Jose Mercury Herald*, November 9, 1944.

"Ames Research Center: Six Decades of Contributions," *AIAA San Francisco Section In4M-Letter*, V. XLIII, No. 5, March-April 2002.

Architectural Resources Group, *Building Evaluations NASA Ames Research Center*, July 25, 2001.

Baals, Donal D., and William R. Corliss, *Wind Tunnels Of NASA*. Washington D.C.: NASA Scientific and Technical Information Branch, 1981. http://www.hq.nasa.gov/office/pao/History/SP-440/cover.htm

"Behind These Walls Destiny Is Being Written," *San Jose Mercury News*, July 25, 1948.

Bugos, Glenn E., *Atmosphere Of Freedom, Sixty Years at the NASA Ames Research Center*. Washington, D.C.: NASA History Office, 2000.

"Close-Up of Compressor Section," *Aviation Week*, March 6, 1950.

Hartman, Edwin P., *Adventures In Research, A History of Ames Research Center, 1940-1965*. Washington, D.C.: NASA Scientific and Technology Information Branch, Office of Technology Utilization, 1970.

Meunger, Elizabeth A., *Searching The Horizon, A History of Ames Research Center, 1940-1976*. Washington, D.C.: NASA Scientific and Technical Information Branch, 1985.

NASA Ames Research Center, *Research Facilities Summary: Two-By-Two Foot Transonic Wind Tunnel*, 1973.

NASA Ames Research Center, *Research Facilities Summary: Volume II-Wind Tunnels; Subsonic, Transonic And Supersonic*, December 1965.

NASA Ames Research Center, *Technical Facilities Catalog*, V.1, October 14, 1978.

NASA Ames Research Center, *Updated Facilities Floor Plans of Ames-Moffett*, June 1, 1992.

Parsons, John F., "Memorandum For Engineer In Charge," Letter to Mr. George W. Gray from John Parsons, May 25, 1945.

United States Department of the Interior. National Register of Historic Places. *National Register Bulletin 15: How to Apply National Register Criteria.*

United States Department of the Interior. National Register of Historic Places. *National Register Bulletin 16A: How to Complete the National Register Form*, 1991.

United States Department of the Interior. National Register of Historic Places. *National Register Bulletin 22: Guidelines For Evaluating And Nominating Properties That Have Achieved Significance Within The Past Fifty Years*, 1979, Revised 1998.

United States Department of the Interior. National Register of Historic Places. *National Register Bulletin 39: Researching A Historic* Property, 1991.

United States Department of the Interior. National Register of Historic Places. *National Register Bulletin: Guidelines For Evaluating And Documenting Historic Aviation Properties*, 1998.

"Work At Ames Lab. Proves Eye Opener," *Daily Palo Alto Times*, July 11, 1950.

VERBAL BOUNDARY DESCRIPTION

The boundary for the historic property encompasses the building envelope for the wind tunnel building and related machinery collectively identified as N-226 and located at the southwest corner of the intersection of Boyd Road and De France Avenue.

BOUNDARY JUSTIFICATION

The boundary was selected in order to include the original wind tunnel building that housed the test section and interior portions of the wind tunnel, and to also include the exterior wind tunnel portions located directly behind the building (to the west). The exterior portions include the original cooling coils, compressor and drive motors, the wind tunnel cooling tower, and the dry air storage tank.